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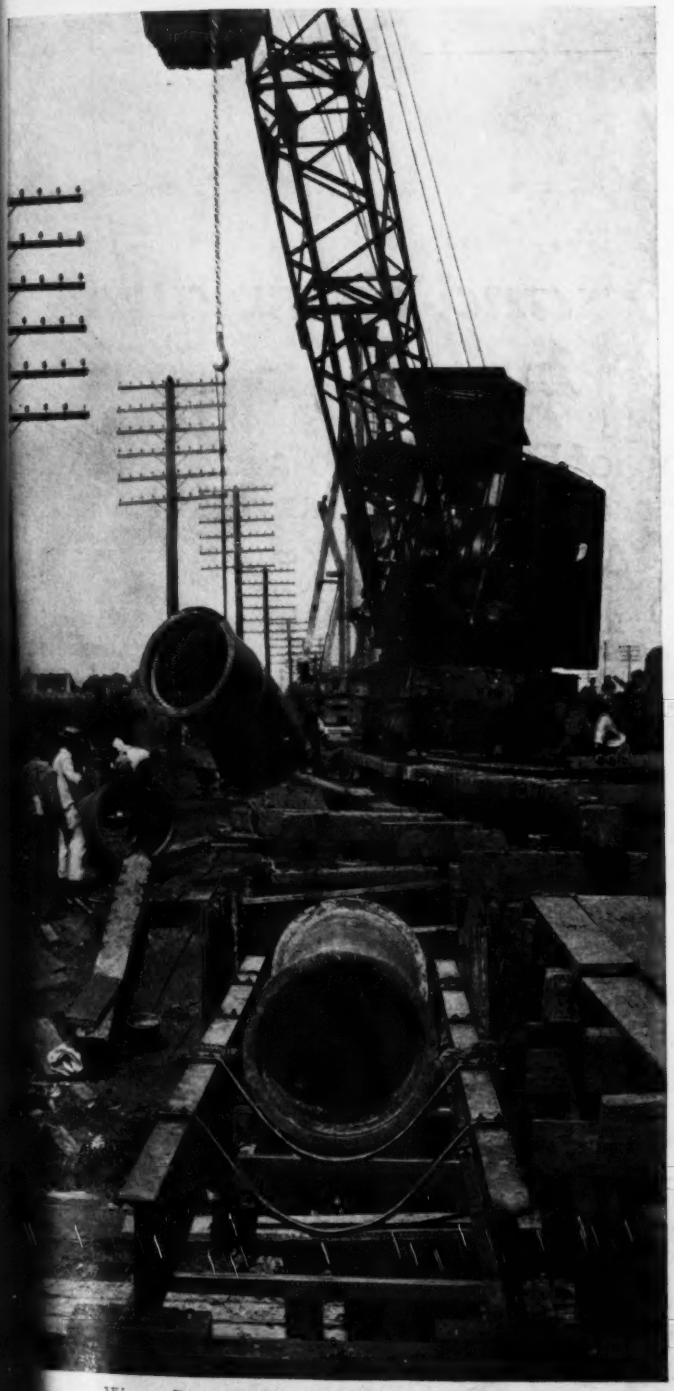
Engineering News-Record



Water Pipe Laying in New Orleans Swamps

Water-Works Articles in This Issue:

Welding Field Joints and Laying Riveted Steel Pipe

Laying Large Water Main Through Swamps in New Orleans

Water-Works Improvements at Wheeling, West Va.

Discharge Measurements for the Control Section Weir

Marshfield, Wis., Gets Well Water Supply After Twenty-five Years' Search

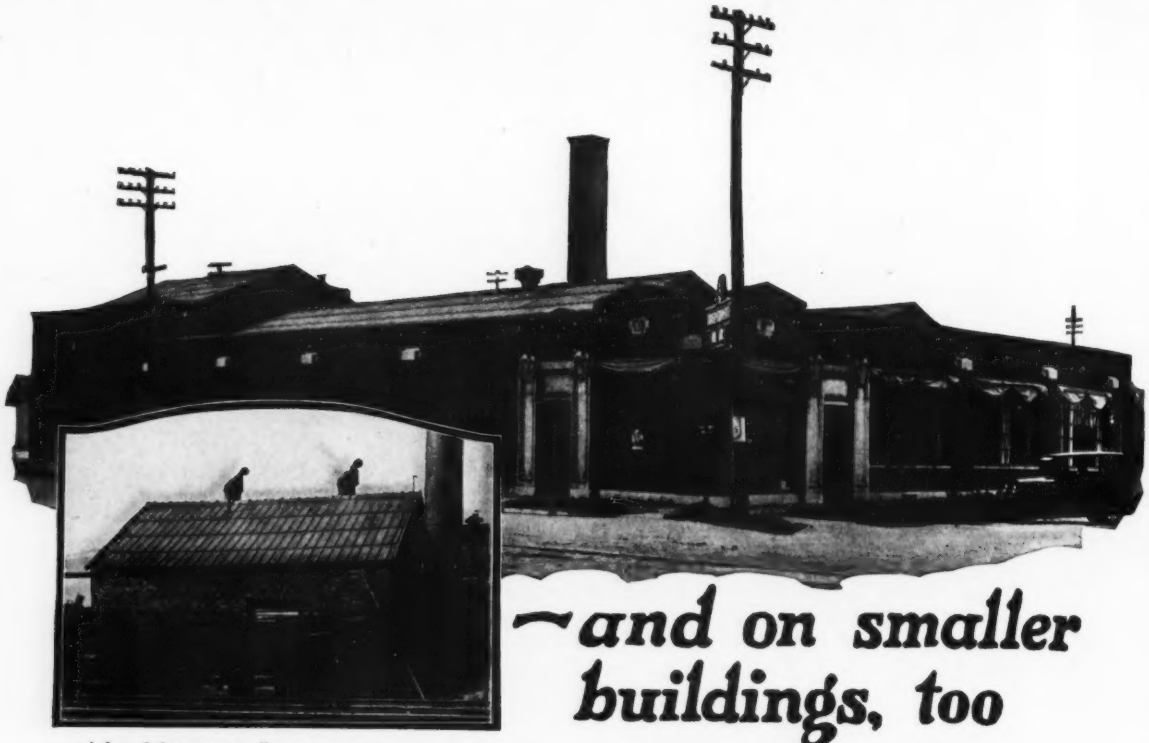
Venturi Speed Controller for Dry Chemical Speed Device

Small Water Purification Plant for Jacksonville, Texas

Additional Pipe Conduits of the Catskill Aqueduct

Also:

Job and Office Articles on Water-Works Design, Construction, Operation and Repair



—and on smaller buildings, too

A few of the many smaller buildings that have been "roofed for permanence" are shown on this page.

Federal Cement Tile is made for flat and pitched surfaces.

—fire proof Federal Roofs have proved cheaper than the inflammable kind

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 92 NEW YORK, MAY 15, 1924 Number 20

Unique Water Main Jobs

UNIQUE water main construction jobs in three widely separated cities stand out among the articles assembled in the following pages in recognition of the convention of the American Water Works Association in New York City next week. The chief city on each of our American seaboards—Atlantic, Gulf and Pacific—is represented. Features of the New York article are the use of labor-saving equipment, the pipe coating used, and submarine pipe laying across the Narrows between Brooklyn and Staten Island. At New Orleans there were pipe hauling by mules on log wagons across quaking ground; trenching through roots and stumps sheared off by sheet piling; heavy anchorage of pipe and manholes at quarter bends; and other details incident to New Orleans conditions. Welding field joints, adjustments to curves, and lowering long sections of pipe so welded into the trenches, the latter by means of tripods on level or nearly level ground and timber cribs to prevent overturning on grades of more than 5 per cent, stand out in the San Francisco work. These three jobs illustrate the diversity of problems met and the resulting ingenuity displayed in American water-works construction. That this country has no monopoly on ingenuity is illustrated by the story of putting a patch on a steel water main in an awkward corner of a bridge at Shanghai, China, which is one of a number of short practical water-works articles in this week's Job and Office Section.

A.W.W.A. Progress

FAR-REACHING plans for the continued upbuilding of the American Water Works Association are disclosed in the advance copies (in May *Journal*) of the report of the Standardization Council, of which George W. Fuller is chairman, and of Mr. Fuller's address as retiring president of the association. We say "continued upbuilding" because the progress of the association for a number of years past has been accelerated and the grade raised by the four years' work of the council just mentioned. The embarrassment of riches flowing from the work of the council and its many sub-committees—riches in the form of progress and research reports and papers—is to be met, the council announces, by bringing out a Manual of American Water-Works Practice, to be put on the market like any book. Another problem is left—how to provide for ample discussion of research work reports, to bring out, correlate and crystallize the experience and judgment of members of the association on the many branches of practice which the sub-committees are studying. The yearly convention, with its overcrowded program, is insufficient for the purpose just indicated, even when this is supplemented by the publication of papers and reports in the association *Journal*, with invitation to submit written discussion. The council proposes that the geographical sections be used to bring out discussion. In addition, Mr. Fuller proposes three national divisions of the association, apparently with parallel meetings at the convention. These would be: (1) Plant Management and Operation. (2) Water Purification Control. (3) Fire Protection. This would be an extension of a practice already followed slightly for several years past, when the Laboratory Section has held sessions on one day of the annual convention. With these and many other live topics to come before the convention of the association in New York City next week, an unusually successful meeting and a record-breaking attendance should be assured.

James Buchanan Eads

ON TUESDAY of this week the bust of James Buchanan Eads was unveiled as the representative of the engineering profession in the Hall of Fame at New York University. Fame is at best an indefinable thing and to select from the great body of departed engineers that single one who is entitled to sole honor above his fellows is well nigh impossible. Eads has been dead nearly forty years, so the peak of his activity goes back a half-century to a period before the modern development of engineering this journal celebrated a few weeks ago. But in his own time he loomed large—because of his versatility and of the spectacular nature of his enterprises. Of these enterprises only two—the St. Louis bridge and the Mississippi jetties—remain or are much known, but his fertile brain roamed the whole field of engineering from iron-shipbuilding to mammoth ship railways. He was the fine flower of pioneer engineering—an active and orderly mind applied to the ingenious solution of virgin problems. The like will not be seen again, for the day is passed when native wit is sufficient to the engineer. Precedent is building up, theory is developed, standards are established. Few problems are longer entirely new. The successful engineer of the future is the one who can combine an original turn of mind, such as Eads possessed so superlatively, with a proper respect for what has already been done, which Eads considered not at all. But fame is for those who have gone—and of all the engineers who have made the way clear for us today probably Eads typifies as well as any the spirit of ingenuity which gave the profession its name.

One Virtue in Pessimism

CERTAIN lines of business, notably the textiles and leather, have shown a decided falling off in the last month and this has let loose a number of conjectures as to the possibilities of an extension into a general depression. The very fact that this possibility is being so widely explored is in itself the best sort of insurance against its occurrence. Panics are caused by a variety of things, but over-confidence is as near

a major cause as any one thing. The individual business that every so often stops to take stock of the immediate future possibilities of decline is going to be best prepared against that decline, because it is not going readily to be over extended. Outside of the uncertainties of legislation and the usual doubts of a presidential year, underlying conditions are sound. There has been no inflation of prices or of credit, there is little surplus stock, there are few speculative advance orders. Trade in general, while not up to the boom of the early months of the year, is good, unless one calls trade good only when it is exceeding all previous records, which is a tendency too easily followed. Construction, the major balance wheel of industry and the forecast of later production, remains high, though not as high as at this same time last year. A census of the manufacturers serving the construction field shows them to be almost unanimously optimistic of the future and satisfied with the current demand. This is not going to be a runaway year in production or consumption but there is nothing in sight to cause panic.

Road Location by Legislation

FOR a second time Governor Smith of New York has disapproved a bill changing and adding to the state highway system determined by the division of highways of the State Department of Public Works. He furthermore emphasizes the repetition by expressing the opinion "that the constitution should be amended in order to prohibit the laying out of highway routes by legislative enactment." Few heads of state governments have had the courage to take bold action against the practice of political log-rolling in placing the state roads. Indeed the habit has been to condone if not openly to support the practice. A precedent has been set in New York, therefore, which gives encouragement to highway engineers over the country. There is no feature peculiar to New York in the situation which the Governor of New York so sharply censures. Unrestrained increases in system cost; parallel routes; dead-end roads, and routes diverted to satisfy some personal interest or a particular branch of a constituency are common in every state where the expert task of state-road-system location is a function of the legislature. Governor Smith is perfectly right in his opinion that the technical tasks of state highway development should be taken from the hands of the state's legislative assembly. Not only should it be done in New York but in every state. Highway-system determination, trunk-road selection, traffic routing are difficult problems, with the present dearth of transport data, even for the skilled highway engineer. Only such trained officials, however, may assume to undertake their solution.

Income Tax or An Automobile

ONE out of every 10 persons in New York State pays a federal income tax and one out of every 14 owns a passenger automobile. In Iowa only one out of every 22 pays the tax but one out of every 5 owns his car. Many different morals could be drawn from these figures, which are fairly representative of the states in the manufacturing and financial East and in the agricultural West. Moralizing aside they give some inkling of why Iowa and the agrarian West want super-taxes kept up and care little whether plain income taxes are reduced and why New York and the taxpaying East are crying for tax reduction all along the line.

Tulsa Gets Mountain Water

LESS than twenty-five years ago Tulsa, Okla., was a cowboy town with broncho hitching posts lining its dusty streets. Today it is spending $7,000,000 to bring mountain water to its 100,000 inhabitants through one of the longest reinforced-concrete pipe lines yet attempted. Oil made Tulsa. Oil also spoiled or helped to spoil its old water supply by increasing its common salt content beyond the tolerance point. Even the spigots turn green. A good modern filter plant was installed in 1918 and although it has always been able to produce a clear, sanitary effluent from one of the hardest, most turbid and unpalatable waters of the Southwest, it could not remove salt.

Water has furnished Tulsa with more than its quota of thrills, newspaper and political controversy. There were three sources to choose from—the Arkansas River at its door step, the privately-developed and at best temporary Shell Creek supply, storing a good water from but 20 sq. miles of catchment area, and the mountain water from Spavinaw Creek. Like Los Angeles, Tulsa decided to span the distance between mountains and town, though it pushed the per capita debt to the top of the list of American money-spending cities. Rejection of the Shell Creek supply even for temporary use made speedy construction of the mountain system all the more insistent.

How every minute was conserved by the engineers immediately after the project was authorized is a story that will never be adequately told. Four days after the engineer's contract was signed, fifty men in five wagon-camp crews were at work on the survey of the pipe line, for every one realized that this long line, of all the features, would take the most time. Check had to be made of the government maps which showed 50-ft. contours only. Quick location of parties on the ridge through which the tunnel must pass was essential. Just what is a main ridge and what is not when only 75 ft. gradient was available in the 55 miles from the mountain dam site to the reservoir near the city required the best that was in more than one old railroad locator. In addition to a hydraulic grade line conduit, location of a railroad alongside the pipe line had to be considered. Of the five lines run the final major location problem resolved itself into balancing a longer tunnel against a longer pipe around a certain hill, taking into account all the factors including the railroad. Whether the absolutely best line was found will likely never be determined for a pipe-line location once determined is seldom changed whereas railroads are not infrequently relocated.

Construction of the work has not been uneventful. Getting away at the start was difficult since untried methods appeared in the low bid. Personalities clashed, but that is always expected in the Southwest country. The contractor, seemingly the soundest, has had to be relieved of his job but the work goes on, the city's engineers taking up the burden. Organizations have interfered at times with the labor. So-called "Squirrel

Hunters" of the Spavinaw region at one time threatened "Boston-Tea-Party" tactics but were placated when the fifty imported Mexicans conveniently filtered away to the cotton farmers where their services were "badly needed."

Oil-made Tulsa will get mountain water this year. Once more engineers have delivered the goods, added to a community an essential betterment and removed indefinitely any barrier on that score to the continued growth of a city.

A Bill Worthy of Support

BILL H. R. 8836, introduced in the lower house of Congress a few days ago by Representative Addison T. Smith of Idaho, is entitled to the earnest and enthusiastic support of the engineering profession. It is a bill to remedy defects in the Reclamation Act in the light of accumulated experience, and is well described in its title, "A bill to provide safeguards for future federal irrigation development and an equitable adjustment of existing accounts on federal irrigation projects, and for other purposes." Its provisions express the conclusions of the Board of Special Advisors, which recently reported. The serious ailments and vices of the reclamation situation as brought out in our series of articles last fall are all taken into account. It brings to fruition what the engineers of the irrigation country learned in their many disappointments and troubles of the last two decades; and because of that long experience it is fitting that engineers everywhere should lend their voice to promoting the enactment of the bill into law.

A few of the things it prescribes may be noted here: No new reclamation shall be undertaken until reports on its irrigation, land cost, soil, climate and markets are obtained, and until a contract is made with an organized district. Land value shall be fixed by appraisal, and when a settler sells his land half the excess over the appraised value shall go to repay construction charges. Private holdings exceeding 160 acres must be transferred to the government or put under contract to sell at the appraised value. Settlers must show adequate qualifications, and must have some capital. The construction charge may be fixed according to productive value of the land. Annual repayments are to be 5 per cent of the average gross crop return of prior years. The secretary may employ trained farm and economic advisers to assist the farmers, and may loan them up to $600 to buy equipment or live stock, on short-time chattel mortgage. Operation and maintenance charges must be paid in advance. With regard to present projects, the twelve per cent penalty on delinquent accounts is reduced to six per cent. Profits from power, leases and townsite sales are to be credited to the water-users. Repayment may be suspended when a farm is not sufficiently productive; and when it cannot even support a family it may be exchanged for a better farm. Construction charges may be adjusted by the secretary at any time to what the land can bear. The cost of conducting the Washington office and the cost of preliminary investigations are not to be charged against the projects. Finally, an appropriation of $100,000 annually for five years is made for investigations to determine how arid, swamp and cut-over timber lands may best be developed in future to meet agricultural needs.

These provisions appear admirably suited to promoting and protecting reclamation development. They should go far toward remedying the ills of reclamation; let them be enacted into law.

Treating Garbage and Sewage Together

A COMBINATION of garbage and sewage disposal has often been proposed and here and there practiced, at least to the extent of locating the plants side by side and handling sewage and garbage residue more or less closely together. A novel scheme of combining these two classes of disposal works has been tried on a working scale at Lebanon, Pa., and it is now proposed to adopt the system for the entire garbage of that city. Details are given elsewhere in this issue.

If this combined system proves to be feasible for general use its adoption would shorten the haul for garbage disposal materially. The garbage grinding plant or plants could be placed over the main outlet sewers and in larger cities over tributary mains as well, letting the sewage transport the ground garbage to the sewer-works, as has been done and is proposed at Lebanon. Some engineers may question the authors' assumption that the volume of the garbage solids added to that of the sewage solids would be immaterial in the operation of Imhoff tanks and other parts of the sewage-works where the treatment goes beyond Imhoff tanks. The authors state in the article that the volume of the ground garbage is small compared with that of the total volume of sewage and that the garbage is 75 or 80 per cent of water, and that the addition of garbage solids would not materially increase the total sewage solids. Even on the basis of their calculation, it appears that the total solids of the combined plants would be increased some 25 per cent over what the sewage alone would contribute to the Imhoff tanks. There has to be taken into consideration not only the effect of this 25 per cent in itself, but also of the fact that the dry solids in this case, whether of sewage or of garbage origin, will in the form of sludge be vastly increased by water, thus correspondingly increasing the volume of sludge for final treatment and disposal. Moreover, even though the construction cost of a grinding plant is only a fifth that of an incinerator of the same capacity, this difference will be offset to a degree that need not be estimated here by (1) the necessity of enlarging the Imhoff tanks, particularly the sludge-digestion chambers, and (2) the need for material enlargement of sludge-drying beds in order, in each case, to take care of the largely increased volume of sewage sludge as contrasted with the increased total solids on a dry basis.

The possibility that the ground garbage will add to tank foaming and other operating troubles must also be considered, as well as the increased cost of sludge disposal due to the addition of the garbage to the sewage.

Altogether the addition of garbage to sewage will raise considerably both capital and operating expense for sewage-works. To what extent this will be balanced or overbalanced by saving in garbage disposal is an interesting question. It is to be hoped that nothing will prevent the carrying out of the building of the proposed plant for grinding all the garbage of Lebanon and taking it to the sewage-works for treatment with the sewage. If this is accomplished, the results will be well worth following.

Additional City Pipe Conduits of the Catskill Aqueduct

Large Steel Pipe Lines on Land in Brooklyn, Queens and Richmond Boroughs and Cast-Iron Submarine Pipe Line Beneath Narrows of New York Harbor—Design, Coating and Construction

By Walter E. Spear
Department Engineer, Board of Water Supply, Municipal Building, New York

CONSTRUCTION of additional pipe conduits in the city of New York to supplement those originally laid between 1911 and 1915 to deliver Catskill water to the Boroughs of Brooklyn, Queens and Richmond was begun in 1923 by the Board of Water Supply of New York City. The need for these additional conduits has become increasingly evident during the last two years because of the phenomenal growth of the residential districts of Brooklyn and Queens boroughs and the steady increase of population in Richmond borough. The consumption of water in the Boroughs of Brooklyn and Queens has outgrown the capacity of the Long

FIG. 1—PIPE CONDUITS OF CATSKILL AQUEDUCT SYSTEM IN NEW YORK CITY
Original conduits shown by light lines; those of 1923-24 in heavy lines; proposed conduit by broken lines.

Island sources of supply in Kings, Queens and Nassau counties, and the available supply of water in Staten Island has long been insufficient for the needs of the borough of Richmond. The problem of supplying these island boroughs with water from the Catskill system is one of some magnitude; Brooklyn borough is a city in itself of over two million inhabitants; in area Queens is the largest of all the boroughs of the city with a widely scattered population; and Richmond borough is the most distant from the sources of the Catskill supply, as well as the most elevated section of the city. Until another city tunnel is built, all these boroughs must be supplied with Catskill water from the two terminal shafts of the present city tunnel, which are situated but a mile and a half from the East River in the downtown section of Brooklyn. The large conduits which are obviously necessary to supply the outlying centers of population must be considered as interborough aqueducts rather than as distribution mains and, unlike most aqueducts, these large conduits must be largely laid in the congested city streets.

The locations, sizes and type of construction of the conduits that were previously laid, those now under construction and now proposed are shown by Fig. 1. Except for the cast-iron submarine pipe line across the Narrows from Brooklyn to Staten Island, all of the conduits now under construction are steel pipes and most of them 72 in. in diameter. One of the new lines, extending from Shaft 23 of the city tunnel at Flatbush and Third Aves., Brooklyn, to Silver Lake reservoir in Richmond borough, comprises the Park Slope and Fort Hamilton conduits in Brooklyn, 41,430 ft. in length; the Narrows Siphon No. 2, 9,400 ft. long, across the Narrows; and the Clove conduit, 16,600 ft. in length, in Richmond borough. Excepting the last conduit, which has just been started, these conduits were well advanced in 1923 and will be finished this year by midsummer. These conduits are intended primarily to supply Richmond borough, but direct connections with the mains of the Brooklyn high service are provided and the intermediate and low services in South Brooklyn and Bay Ridge will be benefited by relieving the original Brooklyn and Bay Ridge conduits of the present supply to the high service and of the draft to Richmond borough. The Mt. Prospect conduit is an independent line in Brooklyn borough, 16,800 ft. in length, which is now approaching completion. It is being laid from Shaft 24 of the city tunnel in Fort Greene Park to the Flatbush district to supply certain Brooklyn intermediate service districts now served from Shaft 23 and by that much to relieve the latter shaft of excessive draft. This conduit will also supply several low-service areas in Brooklyn and will give some slight relief to northern Queens by providing for a portion of the draft in Brooklyn borough now drawn from the original Queens conduit. Another line, the Williamsburg conduit, not yet under contract, will be laid from Shaft 24 to Long Island City in Queens borough through the Williamsburg and Greenpoint sections of Brooklyn, and will materially improve the water supply of northern Queens borough and increase the pressures in these Brooklyn districts.

Steel Pipes—The design and manufacture of the steel pipes for these new conduits and the methods of laying the pipes differ only in some minor details from those of the conduits previously laid, but present labor conditions have radically changed the methods of excavation and backfilling employed on the old conduits, and the pipe coatings on the new conduits are worthy of some note. The use of steel pipes in place of cast-iron has greatly increased during the past few years because of the economy of steel pipes for conduits of large size and their greater reliability.

The specifications for the new conduits call for riveted joints and require the pipes to be made up in sections not less than 30 ft. in length, fabricated in taper courses 7½ ft. long, with double-riveted lap joints for the longitudinal seams and single-riveted lap joints for the transverse seams. It is specified that the smaller end of each taper course of pipe when laid shall be at the downstream end. The Clove conduit in Richmond borough is being made throughout of riveted pipe, but other than riveted joints, if of equal or greater strength, are permitted under the specifications without any allowance in thickness of plate or in diameter of pipe. Permission was therefore given to make the

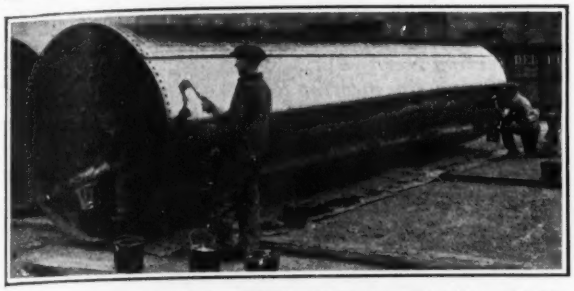


FIG. 2—COATING 72-IN. STEEL PIPE IN STORAGE YARD AT BROOKLYN ARMY BASE

straight sections of the steel pipes for the Mt. Prospect, Park Slope and Fort Hamilton conduits in 30-ft. taper lengths with two longitudinal lock-bar joints and single-riveted lap joints for the transverse seams. Most of the pipes are being fabricated of $\frac{7}{16}$-in. steel, but those 72 in. in diameter, which may be exposed to pressures exceeding 110 lb. per square inch, and all of the reducers are being made of $\frac{1}{2}$-in. plate. All plates are of flange steel made under the Standard Specifications for Boiler and Fire-Box Steel for Locomotives, Serial designation A30-21 of the American Society for Testing Materials. A special oval-head rivet of boiler rivet steel, slightly countersunk, which might be called a "Liverpool head," is specified for the inside of all pipes.

Pipe Coating—When steel pipes for the delivery conduits of the Catskill system in the boroughs of Brooklyn and Queens were being considered by the engineers of the Board of Water Supply between 1911 and 1914, the problem of suitable pipe coatings received much attention. The Brooklyn conduit, the first of these steel pipe lines, was coated in 1912 with a standard asphalt dip, but among other protective coatings applied experimentally to a portion of the Queens conduit in 1914, 2,000 ft. were coated inside and out with bitumastic solution and enamel, coal tar products that had been used successfully for some years on marine work and are still so employed both in this country and abroad. An inspection of the steel pipes of the Queens conduit in April, 1921, after they had been in service nearly seven years, found the bitumastic enamel in excellent condition, much better indeed than the asphalt dip with which most of the pipe line was covered, and better than the other experimental coatings that were tried out on short sections of the line. The bitumastic enamel on the Queens conduit was brushed down thin for the purpose of getting a smooth surface, as the specifications permitted a maximum thickness of only $\frac{1}{8}$ in. and required a minimum of but $\frac{1}{32}$ in.; the thinness of the coating appeared to be largely responsible for the few small tubercles noted on the bottom of the pipe where some walking occurred after the line was finished. In preparing the specifications for the additional pipe conduits, last year, bitumastic solution and enamel were specified, but less stress was laid upon brushing the enamel down smooth and a minimum thickness of solution and enamel of $\frac{1}{16}$ in. was prescribed and a maximum of $\frac{1}{8}$ in. allowed. The thicker coating is believed to insure a more complete insulation of the steel surfaces and a minimum number of pin holes and abrasions in the coating.

The bitumastic enamel is a refined coal-tar composition with 20 per cent or more of mineral filler to give the proper body or consistency. From 40 to 60 per cent of the coating is soluble in carbon disulphide and the melting point under the ball-and-ring test is from 160 deg. to 170 deg. F. The bitumastic solution is of the same composition, without the filler, that has been cut with a naphtha solvent so that it is liquid at ordinary temperatures. The solution is used as a priming coat for the enamel to secure adhesion to the metal surfaces. Before the pipes are fabricated at the shop the steel plates are first pickled to remove all mill scale. After the hydrostatic test of each section and a thorough cleaning of all surfaces, a first coating of the bitumastic solution is brushed on cold to protect the pipes from rusting during their transit from the shop to the storage yard near the site of the work. There, before delivery to the work, they receive a second coat of the solution and within a few hours thereafter a hot application of the enamel. As shown in Fig. 2, a photograph in the storage yard at the Brooklyn Army Base, the enamel is brushed on the outside of the pipes in a transverse direction, and on the inside longitudinally

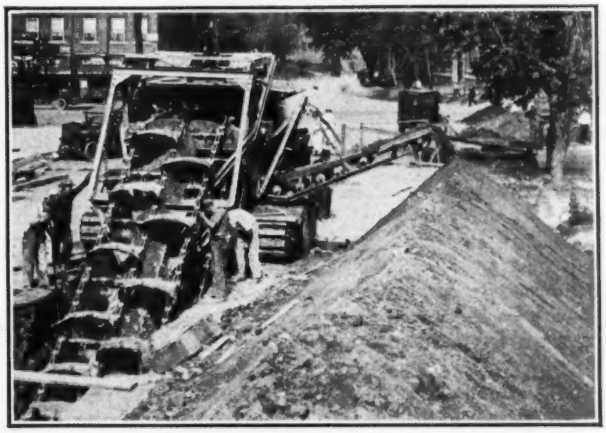


FIG. 3—TRENCHING MACHINE ON 72-IN. STEEL PIPE LINE, FT. HAMILTON PARKWAY, BROOKLYN

to provide a minimum of resistance to the flow of water. No coating other than the shop application of the solution is placed at the field joints until the pipes are riveted and calked, and then, after a priming coating of solution, the enamel is applied hot inside and out as at the storage yard. No difficulty in applying this hot coating to the inside of the pipe is experienced, providing the direction of the currents of air in the pipe is noted and the workmen remain to the windward of the coating materials. Necessary repairs are made to the coating as the pipes are laid in the trench and covered up and some touching up is done after the pipes are tested. About 2,500 ft. of the Fort Hamilton conduit, comprising 72-in. and 66-in. pipe, were coated with Briggs tenax solution and Briggs ferroid enamel, which appear to be not unlike the bitumastic solution and enamel.

Compared with the original conduits laid under pre-war conditions, little labor is being employed in laying the new steel conduits. Labor-saving equipment is used almost exclusively in excavating and refilling the trenches and, to some extent, in placing the pipes in the trench. After the paving over the trench is broken up by air hammers or pavement breakers, the upper portion of the trench, representing the surplus excavation, is removed with steam shovels or cranes using

orangepeel or clamshell buckets and hauled away in trucks. This first cut is about 3 ft. in depth, and this permits the removal of the small water, gas, electric light and telephone services that cross the trench and the changing or removal of many of the larger pipes and ducts at intersecting streets, after which the remainder of the trench is excavated by steam shovels, cranes or trenching machines. The pipes are delivered

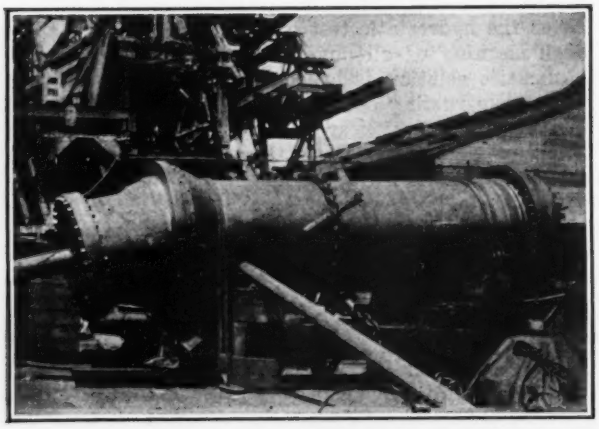


FIG. 4—EXPERIMENTS ON FLEXIBLE JOINT FOR 42-IN. CAST-IRON SUBMARINE PIPE, CLIFTON, N. Y.

to the work as required and promptly laid, using pipe derricks or cranes, and then, after all small pipes and ducts are replaced, the trenches are refilled except at the field joints. Riveting and calking are done with compressed air furnished either by portable gasoline-driven compressor units or central compressor plants. When a section of one of these conduits has been satisfactorily tested to a pressure corresponding to the elevation of Hill View reservoir the field joints are coated, the refilling of the trench is completed and the refill is thoroughly flushed. Over such wide and deep trenches as are excavated for these conduits it is impossible to place the permanent paving until the refill has thoroughly settled and compacted, so that it is necessary to maintain a temporary surfacing for several months.

One of the trenching machines used in excavating the pipe trenches is seen in Fig. 3. As much as 600 ft. of 72-in. steel pipes were laid behind the machine last summer in an 8-hr. day. In 1923 the average daily progress in pipe-laying on the Mt. Prospect conduit was about 80 ft., on the Park Slope and Fort Hamilton conduits, about 168 ft.

Cast-Iron Submarine Pipe-Line—Since 1917, the Borough of Richmond has been dependent for its necessary supply of Catskill water on one pipe line across the Narrows, the 36-in. cast-iron submarine pipe line, known as Narrows Siphon No. 1, and this pipe line is now being operated to its full capacity. The breaking of this pipe line on Feb. 2, 1922, presumably by the spud of a heavy dredge working in the Staten Island slip, focused attention on the need for another line. Favorably located as this break was, where it was possible to work at all stages of the tide, it took just a month to make repairs and place the pipe line again in service. (See *Engineering News-Record*, March 2, 1922, p. 346.) The new submarine pipe line, designated as Narrows Siphon No. 2, is of design similar to that of the original line, though it is 42 in. in diameter instead of 36 in. and somewhat heavier, the thickness of the metal in the barrel of the pipe being 1⅞ in. (See *Engineering News*, April 30 and Oct. 22, 1914, pp. 946 and 812, and *Engineering Record* of Dec. 19, 1914, p. 656 for description of the original line.) The rapid progress made in laying the new submarine line across the Narrows, the cover of broken stone in the Staten Island slip and the use of the bitumastic enamel as a protective coating on the pipes are the features of special interest.

The flexible joint of the submarine pipes of both the old and the new lines is of the Ward type, in which the lead adheres to the spigot and the inside of the bell is a finished spherical surface. The principal features which distinguish this design from others of the same type are the perfection of the machining and grinding that are required on the spherical surface of the bell, and the calking of the joint to make up the shrinkage in the poured lead by injecting pellets of cold lead and lubricant into approximately the center of the joint by means of two rows of gib-screw holes. The steel tire band shrunk on the bell provides the necessary strength to resist the pressure of the lead injections and to prevent rupture when the joint is over deflected. The injection of lubricant between the lead and the spherical surface of the bell is most important, and it should be pointed out that this is impracticable in any joint in which the spigot is machined and the lead adheres to the bell.

Before the submarine pipes were manufactured a series of tests was made under the contract to determine if the design of the 42-in. pipes that had been worked out from that of the 36-in. pipes of the old line had sufficient longitudinal strength and would give a satisfactorily tight and sufficiently flexible joint. These tests were also required to determine in advance of actual laying operations the amount of lead and lubricant required and the sequence of such injections in the two rows of gib-screw holes. The experiments were carried on in much the same manner as described in *Engineering News* of Oct. 22, 1914, above mentioned. A special spigot piece was used for the most part in these experiments and this could be deflected either way from the straight position by means of a lever arm which is shown in Fig. 4, and the stiffness of the joint was measured by the pull, applied at the end of this lever arm, which was necessary to deflect the joint. As showing the importance of getting the spherical surface of the bells as smooth as possible, it is of interest to note that one joint, in which the bell had been machined but not ground, was found to be nearly twice as stiff as the joints similarly made up with pipes having smoother ground bells, and this joint was not as tight. The tests in which the hydrostatic pressures were raised sufficiently to force the spigot out of the bell, indicated that the 42-in. flexible joint had a longitudinal strength of 140 to 160 tons.

An examination of the bitumastic enamel on both the inside and the outside of the pipes of Narrows Siphon No. 1, when the repairs were made in February, 1922, showed this coating to be in good condition and there was little sign of tuberculation after seven years. The same coating was accordingly specified on the submarine pipes of the new line and on the standard cast-iron hub-and-spigot pipes of the shore connections, and this coating was applied in the same way as to the steel pipes of the new conduits and was made equally thick. A shop coating of bitumastic solution was put on the

finished pipes at the foundry before shipment and a priming coat of the solution was applied at the storage yard just before the hot enamel was brushed on. Fig. 5 shows the pipes being coated in the storage yard at Greenville, New Jersey.

The shore end of the submarine pipe line at the Staten Island slip was pulled down the slope of a sheeted trench on a track placed by divers and the pipes at the Brooklyn shore end will be similarly placed. Most of the submarine pipes, however, were laid, last year, across the Narrows in a dredged trench by means of a launchway dragged along the bottom of the trench and supported at the upper end by means of a heavy cable sling from the large derrick boat shown in Fig. 6. This launchway was 148 ft. long and was made up of two twelve-panel Warren trusses of steel connected by steel struts and tierods and so proportioned as regards the relative lengths of the upper and lower chords as to give a deflection of 8 deg. in the lower seven panel points. Cables attached to the bottom of the launchway took a part of the load when it was moved and additional buoyancy was provided by an air-tank attached to the lower end.

The joints of the 42-in. pipes were made up at the top of this launchway from working platforms built around it, as seen in Fig. 6. Each joint required about 370 lb. of molten lead poured in the usual way, and 30 lb. of cold lead in pellets $\frac{5}{8}$ in. in diameter and $1\frac{3}{4}$ in. long were forced into the joint by gib-screws. The finished surface of the bell was painted with oil and graphite before pouring the joint and this lubricant was injected into the joint through the gib-screw holes after the last lead pellets were put in to give the joint

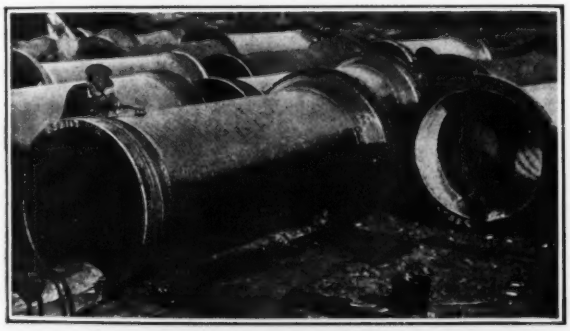


FIG. 5—COATING 42-IN. CAST-IRON SUBMARINE PIPE AT STORAGE YARD, GREENVILLE, N. J.

proper flexibility. The gib-screw holes were then closed with screw plugs and copper gaskets.

As each joint was completed and the uncoated surfaces at the bell were cleaned and painted with the bitumastic solution and enamel, the scow and launchway were pulled ahead and held to proper alignment by means of ten cables on the laying scow attached to heavy anchors set well out on all sides. The pipe line, which was always under some tension, was allowed to slide down the launchway a pipe length in readiness for placing the next pipe. The alignment of the pipes on the launchway was maintained by guides on the top, bottom and sides, and a "trailer" attached to the end of the launchway by a universal joint received the pipes as they left the launchway, straightened out the deflection in the joints and prevented them from falling into minor depressions in the bottom of the trench. The depth of water in the dredged trench varied from 60 ft. below mean sea-level in the Staten Island slip to 78 ft. in the main ship channel. With the exception of a few stormy days and some intervals when waiting for the dredge and when testing the line, pipe-laying was carried on daily during one or two 8-hr. shifts, and from six to eight pipes, representing 72 to 96 ft. of pipe, were ordinarily laid on each shift. The entire 8,140 ft. of submarine pipes laid from the scow were completed

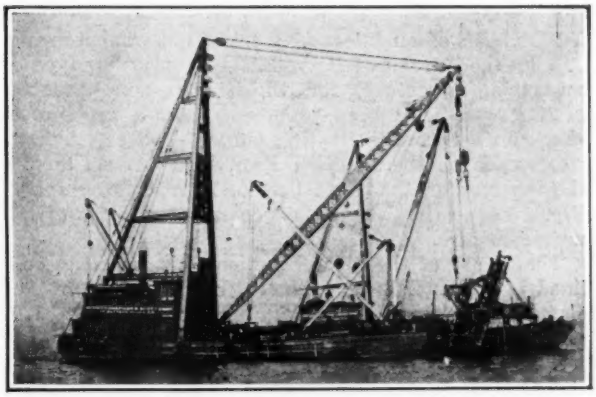


FIG. 6—PIPE-LAYING SCOW AND LAUNCHWAY ON NARROWS SIPHON NO. 2

except for backfilling in the 106 days between Aug. 31 and Dec. 14, an average progress of 71 ft. per day.

Occasionally hydrostatic tests were made on the individual joints as they were made up on the launchway but no leaks were ever found. A tight bulkhead was placed in the end of the pipe first laid, and, before backfilling over any section of the trench, the whole line was subjected to an air pressure of 50 lb. per square inch and the line examined for any leakage that might develop in joints that had been unduly deflected. The two leaky joints thus found were calked from the outside by divers. Channelward of the Staten Island pierhead line a cover of 8 ft. of sand was placed over the pipes to protect them from anchors as was done on the original line. To prevent a recurrence of the accident which broke the original submarine line in the Staten Island slip, the pipes shoreward of the Staten Island pierhead line were covered with 2 ft. of sand and 8 ft. of broken stone were placed on that.

Cost of Conduits—The estimated cost of the several conduits and the names of the contractors are:

Contract Number	Designation of Conduit	Size of Conduit In.	Length, Ft.	Cost of Conduit at Which Contract was Awarded	Contractor
196	Mt. Prospect	72 in. steel 66 in. steel	10,530 6,270	$995,305	Angelo Paino, Brooklyn, N. Y.
197	Park Slope and Fort Hamilton	72 in. steel 66 in. steel	39,290 2,140	2,338,805	T. A. Gillespie Co., New York, N. Y.
198	Narrows Siphon No. 2	42 in. c.i. submarine pipes 42 in. and 48 in. c.i. land pipes	8,800 600	1,523,136	Merritt-Chapman & Scott Corporation, New York, N. Y.
199	Clove	66 in. steel	16,600	677,530	Peter F. Connolly Co., Cleveland, Ohio

These conduits are being constructed under the supervision of the Engineering Bureau of the Board of Water Supply, of which Thaddeus Merriman is chief engineer. R. W. Gilkey, division engineer, is in immediate charge of the work in Brooklyn and R. W. Armstrong is division engineer of the work in Staten Island, including the Narrows Siphon No. 2.

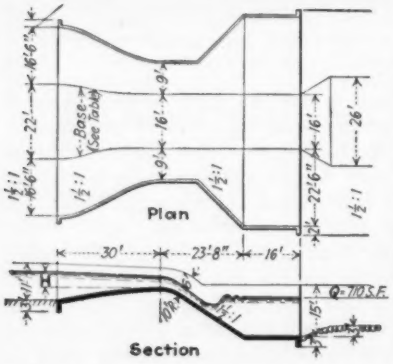
Discharge Measurements for the Control Section Weir

Observations Check Closely Theoretical Rating Curve—New Weir Requires Little Head, No Pool and Single Reading

By J. L. Savage
Designing Engineer, U. S. Bureau of Reclamation, Denver, Colo.

RESULTS of an interesting set of experiments made by the Bureau of Reclamation upon a new type of measuring structure, for which the name "control section weir" has been proposed, show a remarkable check on a theoretical rating curve. The experiments were made on the Klamath Project in Oregon during the summer of 1922 by Allen L. Darr, hydrographer. Fig. 1 shows the design and general dimensions of the weir structure.

The theory of the control section weir is briefly outlined by Julian Hinds, engineer, U. S. Bureau of Reclamation, in *Engineering News-Record*, Dec. 20, 1920, p. 1223, wherein is shown also a close conformity be-



BASE DATA

Sta.	Elev.	Width
2+20	95.00	22.0
+22	95.25	21.9
+24	95.60	21.6
+26	96.08	21.0
+28	96.60	20.0
+30	97.00	18.8
+32	97.30	17.8
+34	97.57	17.0
+36	97.84	16.5
+38	98.04	16.1
+40	98.24	16.0
+42	98.41	16.0
+44	98.53	16.0
+46	98.61	16.0
+48	98.66	16.0
+50	98.67	16.0

FIG. 1—CONTROL SECTION WEIR OF CUTOFF CANAL

tween observed discharges and the theoretical rating for the control section weir. The observed discharges on the Klamath weir were measured with a current meter and are subject to small errors. More exact calibration of a structure of this type is to be made during the next irrigation season at the hydraulic laboratory of the Bureau of Reclamation at Boisé, Idaho, in collaboration with the committee on irrigation hydraulics of the American Society of Civil Engineers. Calibration of the Klamath structure will also be continued during the next irrigation season.

The control section weir is superior to the sharp crested weir or the venturi flume in several respects: (1) It requires less fall than the sharp-crested weir; in other words, it will function with much greater submergence above the crest. The installation illustrated is an unfortunate example in this respect, since the weir is combined with a drop of several feet. A more usual installation of the control section weir is illustrated in the article by Mr. Hinds referred to above. (2) The control section weir can be so constructed that no pool is required above. This construction eliminates all trouble from silt accumulations which have been so troublesome in the operation of sharp crested weirs. (3) As compared with the venturi flume, the control section weir has the advantage of requiring

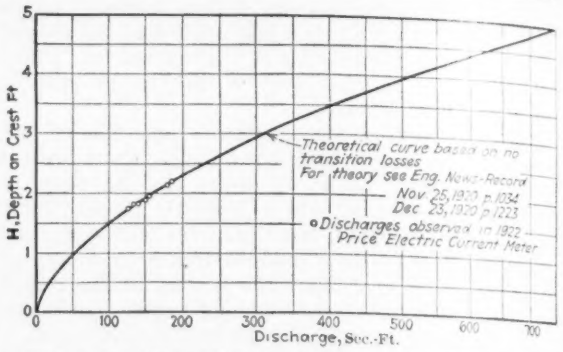

H, Depth on Crest Ft
Discharge, Sec.-Ft.
Theoretical curve based on no transition losses
For theory see Eng. News-Record
Nov 25, 1920 p. 1034
Dec 23, 1920 p. 1223
Discharges observed in 1922
Price Electric Current Meter

FIG. 2—THEORETICAL CURVE WITH OBSERVED DATA

only one reading, which may be taken in the smooth water above the control notch upon an ordinary weir gage. Furthermore, the observed head, which is the total depth over the bottom of the control notch, is much greater than the difference in head observed for a venturi flume and is, therefore, less affected by small errors in observation. The accuracy of the venturi flume decreases rapidly as the flow decreases, which is not the case with the control section weir.

It is therefore evident that the control section weir is likely to give more accurate measurements than the venturi flume and this is particularly true where the observations are taken by non-technical observers.

Unless installed with proper relation to the ultimate operating water surfaces in the canal below, the control section weir has the disadvantage of being subject to "flooding" at part capacity if the water surface is held unduly high by checking or by growths of moss or other obstruction in the canal below. When flooded in this manner the weir degenerates into a venturi flume and two gages must be read for a measurement.

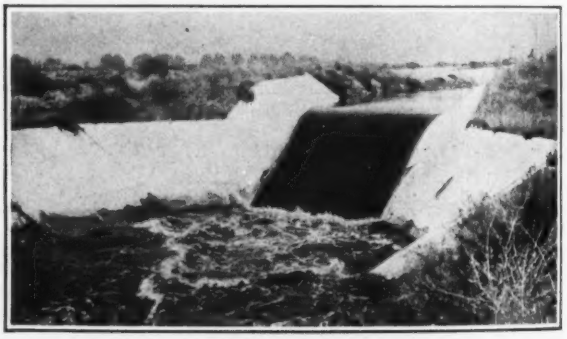


FIG. 3—KLAMATH CONTROL SECTION WEIR PASSING 200 SEC.-FT.

As long as the control section weir is operating freely a standing wave will form at some point below the control. When the structure is flooded this wave will disappear. It is expected that with a properly constructed outlet transition the change from the free-flow to the retarded-flow condition can readily be detected by the change in appearance as the wave disappears.

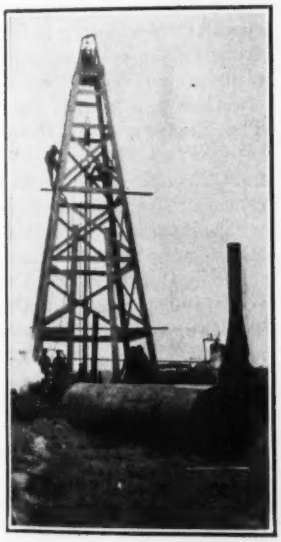
Although the particular structure illustrated is proportioned for a maximum flow of 710 sec.-ft., only a small portion of its full capacity has been utilized to date, Fig. 3 showing the structure with a discharge of only 200 sec.-ft.

Marshfield, Wis., Gets Well Supply After 25 Years' Search

Twenty-One 6- and 8-In. Wells Yielding 0.3 M.G.D. Are Replaced by Five 30-In. Wells Yielding 3 M.G.D.—Well and Booster Pumps

QUEST for an adequate well water for twenty-five years at Marshfield, Wis., has finally been rewarded and early this year the former supply of 300,000 gal. from twenty-one 6-in. wells obtained at an aggregate cost of more than $250,000 was increased to 3,000,000 gal. by the five new wells with gravel-surrounded screening. The old wells and a 30-ft. concrete well 70 ft. deep with screened openings and perforated pipes driven radially from the pit have been abandoned.

Early in 1923 a water famine was experienced. Industrial plants had long ceased looking at Marshfield as a desirable location. Geologists and engineers had reported that a large well supply was impossible, but well contractors employed in July prospected areas surrounding the existing wells and 2½ miles away with 47 test holes. An excellent water-bearing formation was found and the basin and porosity determined. Three well sites ¼ mile apart, to avoid interference, were selected and 30-in. casings put down. A central reservoir with the wells on the circumference of the ½-mile circle surrounding the reservoir as a center furnishes a constant head for the centrifugal pumps, thus permitting continued high efficiencies.



COMPLETE WELL DRILLING OUTFIT

Casing, 16 in., ready to be put into hole. Steam for operating driller furnished by portable boiler and boiler with the steam hoist.

Instead of equipping the wells with a fine-mesh gauze screen which would tend to impede the flow of water, a cylindrical shutter screen with large openings was set in the well opposite the water-bearing formations. The wells were then pumped beyond their normal capacity in order to work out the loose sand. At the same time carloads of gravel were fed in from the top and replaced the sand so that a gravel wall several feet in diameter was formed. Upon completion of the wells, vertical centrifugal pumps were set with the pump bowls approximately 50 ft. below the concrete foundations and the motor and thrust bearing on the surface. A small brick pump house with concrete floor, windows, roof and derrick completes the individual pumping unit.

The three vertical pumps, each having a capacity of 550 g.p.m., discharge into a centrally-located concrete reservoir. A brick building constructed above the reservoir serves as a pumping station for two booster pumps and the automatic control apparatus. The two booster pumps, having capacities of 500 and 900 g.p.m., lift the water from the reservoir into the mains at 85-lb. pressure, which results in a 55-lb. pressure in the city.

The entire pumping system is automatically controlled. When the pressure drops a few pounds, the small booster pump is started automatically. When the water level in the reservoir is lowered 1 ft., an automatic mechanism starts the pump in well 1. If this well cannot supply the demand, the water level in the reservoir continues to lower and well 2 is started. If the water level still decreases, well 3 functions, and in addition the large booster pump is brought into service. The order of operation is changed each day so that the duty of the individual wells and pumps is the same over a given period of time. This means that at all times a constant pressure is maintained on the system and when the supply is not needed the pumps are cut off and a large saving of power results.

OLD WELLS PUMPED BY OIL WELL PUMP JACKS

Pump jacks operated through toggle mechanism by rods running from central station.

To produce 2 m.g.d. the three pumps used between 25 and 30 hp. This presents a very striking comparison to the former system which produced 0.3 m.g.d. per day with 50 hp. Assuming a total of 30 hp. or 22.4 kw., in 24 hr., 537 kw.-hr. would be consumed and 2 m.g. of water pumped, so that 0.27 kw.-hr. is used per 1,000 gal., at a cost of 3c. per kw.-hr.; or 0.8c. is the cost per 1,000 gal. for pumping the water from the wells to the reservoir.

When it was shown that the three wells drilled 1½ miles from the power house produced the required amount, the contractor was granted permission to install two additional wells within the mile limit. He was not required to install the fifth well but did so as an added protection for the water supply. Well 5, which was drilled only 20 ft. from one of the old 6-in. wells, produced 300 g.p.m., while the former well produced only 25 gal. per minute.

The Layne & Bowler Co. made the test investigations and installed the wells for the Marshfield Water, Electric Light & Power Co., a municipal corporation, on a guaranteed basis of 2 m.g.d. or no pay.

Government Gets First Excess R.R. Earnings

The first payment to the Interstate Commerce Commission under the so-called recapture clause of the Interstate Commerce Act has been made by the Richmond, Fredericksburg & Potomac Railroad Co. The amount of the payment was $169,343, or one-half of its excess net railway operating income from the calendar year 1922 as shown by preliminary computations based upon the valuation placed on the property by the carrier.

Venturi Speed Controller for Dry Chemical Feed Devices

Installation at Mechanical Filter Plant, Parsons, Kansas, Varies Chemical Dose According to Rate of Flow of Raw Water

By E. S. Smith, Jr., and C. G. Richardson
Assistant Mechanical Engineer and Sales Engineer, Builders Iron Foundry, Providence, R. I.

A water treating plant recently installed at Parsons, Kan., has a capacity of 8½ m.g.d. The raw water is treated with dry lime, with soda, and sulphate of alumina by chemical feed machines, the speed of which is automatically controlled by a new Venturi speed changer. When one of these machines is set at any particular speed ratio, the proportion of the dry chemical to the raw water is determined, and the Venturi speed controller automatically maintains this proportion at all rates of flow—an essential requirement for continuous water treatment.

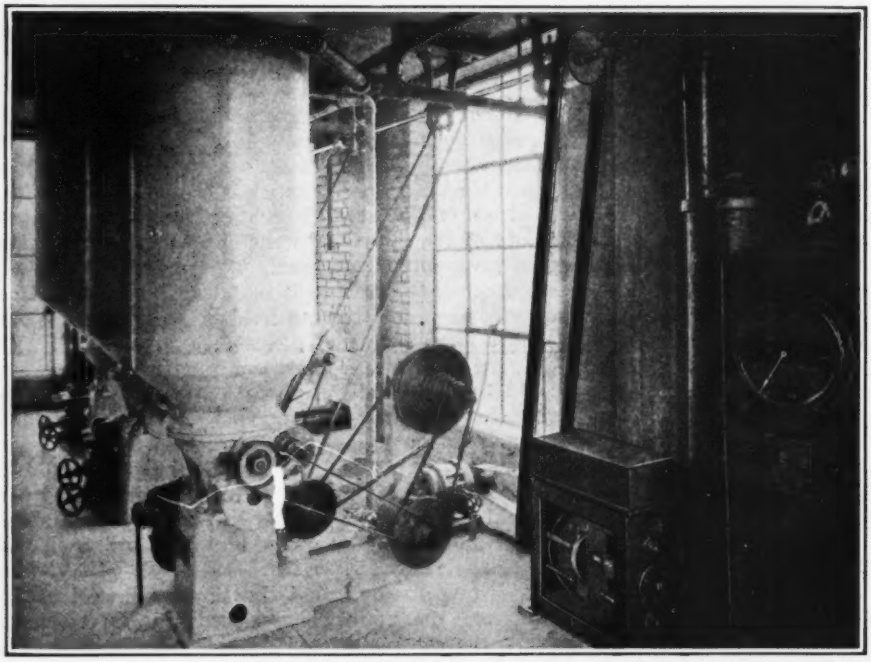


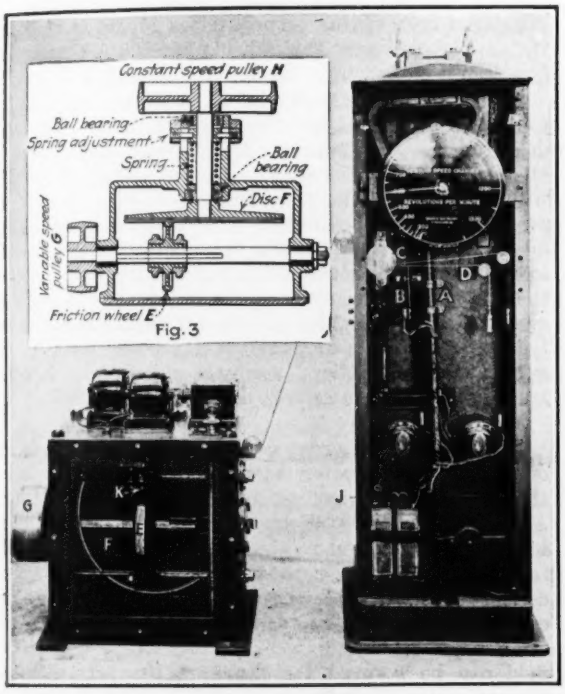
FIG. 1—VENTURI SPEED CHANGER AND CHEMICAL FEED MACHINES IN PLANT AT PARSONS, KANSAS

The installation consists of a Venturi indicator operated by a 20-in. tube of the Venturi type; a speed changer, belt-driven by a constant speed motor; a countershaft, and three belt-driven dry chemical feed machines. The indicator controls the movements of the speed changer and is graduated to show the speed of the variable speed pulley of the speed changer. A separate register, which is located elsewhere, is used to indicate the rate of flow through the tube. This indicator contains a yoke *A* (Fig. 2) supported on knife-edges, which moves in true proportion to the rate of flow through the tube in the raw-water line. As the yoke is of insufficient power to control the speed changer directly an electrical booster is used. The control switch of this booster is a spring *B* which has its lower end attached to the yoke and which makes contact with one of two contact points mounted on the yoke whenever the rate of flow changes. As long as the rate remains constant, neither contact is closed. With an increase in the rate, the yoke moves to the right, closing the circuit through the left contact. The circuit is opened again by a button *C* on the cord *D* from the speed changer. This cord moves in proportion to the distance of the driven roller *E* from the center of the driving disk *F*, and consequently in proportion to the speed of the friction roller and also of the variable speed pulley *G* on the same shaft. At the back of the speed changer (Figs. 2 and 3) is a pulley *H* which is driven by a constant-speed motor. This pulley drives a friction disk *F* which in turn drives friction wheel *E*, slidably keyed to the shaft carrying variable speed pulley *G*. The latter is belted to a countershaft which drives the three chemical feed machines by separate belts. The friction wheel *E* is moved horizontally across the face of the friction disk by the two electric motors mounted on top of the speed changer, one motor moving the wheel from right to left and the other from left to right; respectively increasing and decreasing the speed of pulley *G* in proportion to the axial travel of the friction wheel. The first motor is thrown into service when the rate of flow through the Venturi increases and the second motor when it decreases, through the contacts automatically made by the yoke of the Venturi indicator. As soon as the proper speed has been reached, the button *C* (Fig. 2) acts upon the spring *B*, breaks the circuit and stops the operation of the motor. This spring switch carries only low voltage direct current, from two dry cells contained in the base of the indicating register. This current actuates two relays *I*, which connect the proper motors with the same alternating current supply line that serves the constant-speed main-drive motor. Current is used only during changes in the rate of flow of the water passing through the tube.

This arrangement frees the electrical system from the strain of continuous use and from arcing at the contact points. A battery switch *J* has been provided to protect the dry cells from the steady flow of current which would result if the alternating current line should be disconnected. An additional safeguard is supplied by a circuit-breaking attachment *K* which prevents any over-travel of friction wheel *E* of its proper path from the center to the circumference of disk *F*. Ball bearings are used throughout the power transmission of the speed changer; all parts are easily accessible and of sturdy construction; the "booster" motor-driven gears are noiseless in operation and they are packed with non-fluid oil.

The Venturi indicator shows the proper driving speed of the variable speed pulley of the speed changer, as this speed must be proportional to the rate of flow. Usually the indicating dial will have a second set of graduations showing the rate of passage of raw water through the main supply line in gallons per minute or per day. The friction gear speed changer was permanently adjusted under load in the shop to agreement with the indicating dial throughout the range of the meter.

The chemical feeders are of the screw conveyor type, having the feed ratio determined by a two-speed cone pulley driving seven-speed cone pulley countershafts, and these, in turn, driving the feed screw through



FIGS. 2 AND 3—VIEW AND DETAILS OF VENTURI SPEED CHANGER

another two-speed cone pulley countershaft; thus there are 28 speed ratios for each machine. After the dry chemical has been fed from the hopper by the measuring screw, it drops into a water mixing basin and then into a water jet eductor, which carries it in solution to the water being treated. Two of the machines have divided outlets so that the mixed solution may be delivered to either or both of two mixing tanks. One of these machines feeds dry lime and the other feeds sulphate of alumina. The third machine has only one outlet and while being used at present to feed sulphate of alumina, at times it may be used for feeding soda.

The installation at Parsons responds sensitively to all changes in the rate of flow, and transmits ample power to the dry chemical feeding devices. The latter were supplied by the New York Continental Jewell Filtration Co. of Nutley, N. J., under the direction of P. F. Pew. The Venturi indicator and speed changer were furnished by Builders Iron Foundry, Providence, R. I.

Wells for Water Supply of London, Ont.

THAT further development of underground water supply from the glacial drift would be better and less costly than an additional supply from other sources is the conclusion of a report made recently to the Public Utilities Commission of London, Ont., by William C. Curd, consulting engineer, Chicago. With the population of about 60,000 increased to 76,000 or 80,000 by 1935, the daily consumption should be from 9,000,000 to 12,000,000 Imp. gal., as compared with the present average and maximum of 6,300,000 and 8,200,000 gal. respectively, which latter figures represent the approximate capacity of the present wells and springs. The average per capita consumption is 86 gal. daily.

Sidehill springs in Springbank Park, first used in 1878, have been added to until this source now yields 22 per cent of an annual precipitation of 37.5 in. on a catchment area of 12½ sq.mi. Beginning in 1909 the spring supply has been augmented from time to time by wells. Since 1919 260,000,000 gal. annually have been pumped from the Thames for industrial consumers.

Direct air-lift has been changed to air-lift pumps and vertical centrifugal pumps set in the wells. Iron precipitate in the well water is being removed by aeration without difficulty. Since there has been trouble from fine sand, owing to the use of perforated pipes instead of screens, it is advised that screens be used in any new wells and also in the present wells. A marked recession in static level of water, Mr. Curd states, is due to wells reaching a critical yield. Such a condition usually follows long continued pumping and if the present rate of pumping is not exceeded there should be no recession of level or reduction in yield.

Increased Well Supply—Of the normal 37.5 in. annual precipitation about 40 per cent is disposed of by surface runoff, 40 per cent by evaporation, and 20 per cent, or 7.5 in. as ground water storage. Taking 5 in. as available, each well would require a catchment area of about 2½ sq.mi. to support continuous flow. Mr. Curd is of the opinion that the underground water resources have been barely touched, and he has located the most productive territory in an area of 45 sq.mi. northeast of the city. The glacial drift, very irregular in character and averaging 118 ft. in depth, is underlain by limestone rock, the upper part of which is soft and full of fissures while the lower rock increases in hardness and abounds in hydrogen sulphide gas and sulphur water. Pure water may be obtained at a minimum depth of 40 to 50 ft., providing there is an intermediate clay stratum to seal out surface water.

Wells in new territory should be ½ to ¾-mile apart, and later ones spaced according to the results. The wells should be located not only with regard to the geological formation, but also to the ultimate development of the area, since a central high-pressure pumping station will be required eventually. Hydrogen sulphide, Mr. Curd states, can be removed readily by aeration.

A well diameter not larger than 12 in. is recommended, with vertical motor-driven turbine pumps at 720 r.p.m., instead of 1,440 r.p.m. as in the present wells. The cost of a 12-in. well 100 ft. deep, with motor-driven pump, frame pumphouse, 2,700 ft. of 8-in. pipe line and 2,700 ft. of transmission line, is estimated at 13,000. For the proposed additional well supply of 4,000,000 gal. daily the estimated first cost is $210,000 or $52,500 per million gallons.

Human Qualities Essential in an Irrigation District

One Form of Working Organization and the Qualifications That Fit Into It—Records and Equipment

By George Ebner
Operation Engineer, Valier-Montana Land & Water Co., Valier, Mont.

TO A CONSIDERABLE extent the success of an irrigation district depends on the efficiency of the organization that carries on the work of water delivery and of keeping the canals in condition to carry capacity flow. Poor delivery due to incapable men or to unnecessary breaks in the canals, cannot be tolerated by the water user. Loss of time in irrigation and the accompanying crop loss must be avoided; no district can afford poor service. Securing the best possible result with the least expenditure of money is a matter of great importance. Every dollar spent on operation and maintenance must be taken from the soil, and the carrying of incapable men or unwise experimentation in methods cannot be considered. Men who carry on the work of an irrigation system should believe in irrigation and irrigation farming. An interest must be taken in the general problems confronting the settler, since the ultimate success of the project depends upon the efforts of the settler aided by the irrigation force. They have a common ground and must work with the settler and for him and not let the organization carry on in an arbitrary fashion without due regard to the farm requirements.

Organization—First in the organization is the *project manager* or superintendent. A man in this position should possess a knowledge of the principles of engineering, so that he may properly solve the hydraulic and construction problems which will confront him. The advisability of attempting to prevent canal seepage losses may require consideration. If excessive cutting takes place, additional structures may prove more economical than never-ending canal cleaning. Methods and procedure of the larger problems, both of delivery and maintenance, demand careful solution. The manager should possess an understanding of the broader problems of the irrigation farmer and of the farmer temperament. Many questions relating to the proper location of delivery and waste ditches will come between them. Constructive suggestions, outlining equipment for preparing the land for irrigation, the proper farm lateral system and methods of irrigation should be given the farmer. Land must be reclassified in some instances, and at other times drainage and seepage problems will arise. Claims will be made of failure to obtain good delivery service and of damage resulting from flooding by district or private ditches. In many of these controversies the manager will be the intermediary between the farmer and the board of directors. Some claims will be without any basis of fact, but each must receive careful and impartial consideration. The project manager will need the ability to select and hold a good working organization. To do this demands ability to judge the capacity of each man and to secure his best efforts by fair and considerate treatment. Loyalty to an organization cannot be secured through the matter of salary alone.

The *office assistant*, responsible for the details of the operation and maintenance work, should be well grounded in irrigation engineering, so that he may care for the operation of the main canals and supervise the distribution of water to the districts. If additional structures are required or replacements become necessary he should be qualified to design those structures. He will also be in charge of the office records of the district. He must advise the assistant superintendents in the field of the lands to which water is to be delivered, and see that the detailed records of delivery reach the office in proper form. Under his supervision also are tabulated details of the cost of maintenance work, both structural and canal cleaning. Thus he can determine whether or not the work is carried on economically. Whatever crop census or production report is made in the district will pass through his hands. A timekeeper and record clerk will be needed for the detail work.

An *accountant* is essential to properly care for the payroll expenditures and the material purchased in the department. The inventory of equipment and materials on hand should be handled in this division, and in this way stocks can be kept complete in advance of requirements. Records should be kept showing the location of all equipment and materials in sub-camps over the district. The entire bookkeeping and stenographic work of the whole department can best be handled under the supervision of the chief of this subdivision. All maintenance assesments and charges for water delivery, together with all settlers' accounts and district interest and repayments are kept in detail in this section.

Field Force—In order come the district superintendents as assistant *water masters*. Experience has shown that a field superintendent must be had for about every 15,000 acres. This allotment gives the advantage of local supervision and responsibility. Questions regarding lateral locations, repair of structures or matters of delivery can then receive immediate attention. In the event that the farmer finds it necessary to report to the main office regarding any matter, a report from the field can be secured for the least time and expense. There is also the advantage of immediate supervision of the men employed on maintenance work or ditch riding. Records of time spent and material used are sent in from the field by these men, and they are also obliged to keep a record of the amount furnished each user. They must, of necessity, be men who have had training and experience in this work, and if they have ridden ditch and worked on repair crews, they will have a better knowledge of repair methods and of the problems met by the riders. Men of fair education who have come up from the ranks make the best assistant water masters.

A *hydrographer* is needed to gage the flow of the canals. He will see that all measuring devices, both district and farm, are in proper condition to function accurately. From an operation standpoint the flow throughout the system must be known at all times and the record of the amounts conveyed and of the duty of water to the farm is of value to the district. The work of a hydrographer should be under the general supervision of the office assistant. During the operating season he will work almost entirely in the field leaving the computation of results to the winter months. During the peak delivery season additional record clerks may be required. During the field period when little water is

run, expense can be saved by having the hydrographer perform any transit work that may be necessary in order to keep records up to date, or do any level work needed for locating structures or canal cleaning.

The *ditch rider* is a most important factor in securing good canal operation. Not enough emphasis is placed on the fact that the rider is the contact point between the manager and the settler. It is the writer's experience that a married man between the ages of 24 and 40 will make the best rider. He is more likely to be dependable and tactful than a younger man. The nature of the work requires that he must be able to carry on without constant supervision. Together with the manual labor involved, he must have sufficient education to be able to keep a record of the water deliveries and of the amounts of water, both in the lateral systems and in the farm deliveries. A rider can control 16 miles of distribution ditches serving 4,000 acres.

It is advisable to secure for the ditch riders the longest possible term of employment. By using the rider early in the spring for weed cleaning and on maintenance work when water is not being run, the entire working season is utilized. The riders in each district may form a repair or canal cleaning crew. If additional laborers are needed, the rider makes a good subforeman. A set of small buildings for every rider, with perhaps five acres of land where a cow could be kept and a garden grown, is a good investment. The cost would be met partially by less salary and the balance offset in securing a more stable organization and better results. By hiring cheap riders a payroll saving can be shown for a short time, but before long there will occur structural accidents and canal breaks, with a resulting higher maintenance cost and poorer delivery.

Maintenance and Construction—A structural foreman will be needed for repair, replacement or additional structure work. This applies more especially to larger structures and to work necessary when water is running and the riders are not available for maintenance. His work can be given general supervision by the assistant superintendents. The size of the crew will vary with the needs of the work.

At times a small earth crew is needed to do the lighter cleaning not advisable to do by mechanical means. This crew should not exceed five teams with driver and helpers and the sub-foreman in charge. Farm teams and labor should be used for this work whenever it can be arranged without detriment to the farm program.

It has come to be recognized that mechanical cleaning is less expensive than that done with teams. Labor cost is less, no cook car is necessary, and the machine has a decided advantage in that it can work best with water in the ditches. This is especially important in the northern districts where there is but little working time either before or after the delivery season. A machine runner and helper are needed for each machine and two shifts may be advisable during summer.

A garage foreman and helper are required to keep the motor cars used by the district in good working condition, the gas engines for the pumping machinery, concrete mixers and pile driver which will need inspection and repair. With this division Ford cars for the operation force and light trucks to handle maintenance materials are most economical. The heavier trucks are difficult to handle along ditch banks and in the fields.

Along with the usual requirements that a man be honest, trustworthy and industrious, additional virtues are of value in irrigation operation. There can be no fixed hours of employment during the rush season of water delivery or when structural accidents or breaks in canal banks must be repaired. Usually several seasonal peak demands arise and while these are anticipated by the management, and the rate of pay set accordingly, the men must be fair-minded enough to realize that these extra demands of effort and time are offset by steady employment. Good judgment is required of almost every individual on the force. Structural or canal bank weaknesses must be reported and repaired when necessary, but at the same time the management cannot be annoyed with trivial reports. There is no place in an operating force for the carefree chap who will take a chance and try anything once. The average farmer is prone to discuss matters concerning himself and the wise operation force will keep its tongue well guarded with respect to questions between the settler and the district.

In the organization outlined, duties and responsibilities are fixed without duplication of either. It has been observed that an interlocking division of duties and responsibilities will, in the greater percentage of cases, lead to internal friction. Any outline plan of this sort must of necessity be subject to revision to meet and conform with local conditions. Crop requirements, soil conditions and climatic factors vary greatly, and to carry ideas and methods from one section to another without considering them is to invite failure.

A spirit of pride in the organization and of loyalty to it and the district is built up by demanding good service and is attained when each man is inwardly proud of the fact that he is a member. This spirit brings results in efficiency and economy. Payroll expenditures are easily 75 per cent of the total expense of a going irrigation district. Thus, while every possible economy of operation is to be effected, none is more important than securing a well organized and capable force.

Early Results of Clarifier at Newark, Ohio

CONTINUOUS sludge removal at the new 6-m.g.d. water softening and purification plant at Newark, Ohio, is working satisfactorily even in the "tuning up" period. Results available at the time of writing are meager (see table) but with a hardness reduction from 250 down to 70 p.p.m., and running to 50 per cent capacity (normal detention period 22 minutes), Charles P. Hoover, consulting engineer, reports that 95.4 per cent of the total solids were removed in the Dorr clarifier and 96.2 of the settleable solids. During this test Mr. Hoover says the discharge was opened too wide, giving a sludge that was too wet. The discharge at Newark is controlled by throttling a 6-in. valve but the manufacturers recommend leaving the 6-in. valve wide open, placing on the line a 6 x 3-in. flanged taper reducer, then a 3-in. nipple and a 3 x 2-in. screwed reducer and finally a standard bushing with interchangeable porcelain inserts to give the desired flow

RESULTS OF OPERATING THE CLARIFIER AT 3 M.G.D. RATE

Point of Collection	Suspended Solids p.p.m.	Point of Collection	Suspended Solids p.p.m.
Influent	478	Clarifier, 9 ft. below surface	800
Effluent	22	Clarifier, 12 ft. below surface	830
Settling basin effluent	4	Clarifier discharge	20,108
Clarifier, 6 ft. below surface	206		

Water-Works Improvements at Wheeling, West Virginia

New Intake, Pumping Station with Low- and High-Service Electric-Driven Pumps, Filter Plant with Chemical Dust Arrester and Dry-Feed Machines, and Group of Steel Storage Tanks

By J. F. Laboon
Of The J. N. Chester Engineers, Pittsburgh, Pa.

WHEELING'S new filtration plant will include several extraordinary features of design among which are the feeding of pulverized calcium oxide in dry form, the installation of a dust arrester for unloading and handling chemicals, the control of wash-water and the use of hydraulic plug valves for the drains in the mixing chamber and settling basins. Other interesting features of the extensive water-works improvements are the substitution of electricity for steam in the new pumping station, the sinking of a 40-ft. inside diameter concrete pit 60 ft. deep on a steel shoe, the use of large steel tanks as reservoirs, the negotiation and purchase by the city of the four private water plants now supplying the suburbs and the unification of all water-works in greater Wheeling. The filtration plant will have a capacity of 20 m.g.d. This will provide a per capita supply of 350 gal. daily which is the present rate of consumption of greater Wheeling. It is expected to reduce the present demand to 16 m.g.d. before the filtration plant goes into service next fall by curtailing the present 10 m.g.d. consumption of the industries by means of meters which are now being installed and by means of waste and leakage surveys now in progress. A general plan of the intake works, pumping station and filtration plant is shown by Fig. 1.

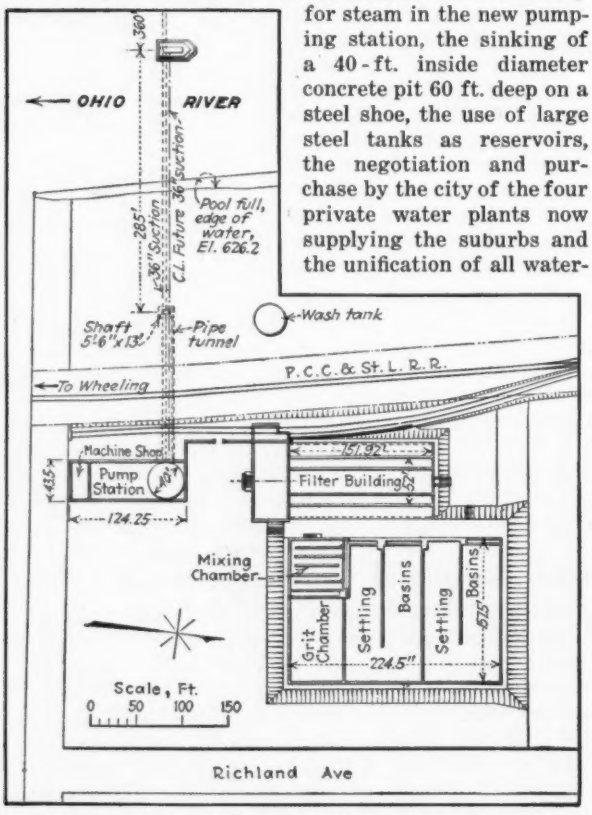


FIG. 1—LAYOUT OF WHEELING INTAKE, PUMPING STATION AND FILTER PLANT

Lime is frequently necessary in the treatment of Ohio River water with its occasional acidity, especially if softening is attempted. Calcium oxide delivered in lump form on the railroad siding at the coagulant house will be unloaded by means of a power shovel into a steel chute extending to the level of the car floor and leading to a hammer crusher located in the basement of the coagulant house. The crusher will pulverize the calcium oxide to such a fineness that 90 per cent will pass a 10-mesh and 50 per cent a 100-mesh sieve. The crusher will have a capacity of pulverizing 15 tons of calcium oxide per hour. The pulverized material will be transported by means of a vertical continuous canvas bucket conveyor and a horizontal screw conveyor to the concrete storage bins on the top floor of the coagulant house where it will be unloaded and stored.

The pulverized calcium oxide will be fed through a manually controlled dry-feed machine and dissolved and slaked in a mixing box underneath, from which point the lime solution will be ejected through flexible rubber hose to the mixing chamber. The application of calcium oxide in dry-feed form will accomplish a distinct saving over hydrated lime fed in the same form due to water content of the latter and the extra freight handling, and even in actual cost per unit of material, besides removing the objectionable features of preparing and feeding calcium oxide in wet form.

A dust arrester is to be installed on the top floor of the coagulant house for removing, during unloading, chemical dust from freight cars, from the chute leading to the crusher, the exterior of the conveyor casing, the elevator shaft and the top floor of the coagulant house where the chemical is discharged into the bins. Connections will also be made to the daily hoppers attached to the dry-feed machine so as to eliminate any dust occasioned by charging the dry-feed machine hoppers. Other outlets will be located at the chemical charging floor, which is the floor next below the concrete storage bins, to catch any dust finding its way through the hopper chutes and from the dry-feed machines. The dust will be filtered out and returned to the storage bins.

Wash-water will be controlled in rate by means of a Venturi rate controller, manually operated so that the rate of flow will be constant regardless of the head in the tanks or the back pressure from the filters. The controller will be located in the 24-in. wash-water line in the basement of the coagulant house. An integrating, registering and recording gage will be installed on the master control table in the first floor lobby. The wash-water will be stored in a 125,000-gal. elevated steel tank. Two motor-driven centrifugal pumps, each having a capacity of 1,000 g.p.m., automatically controlled, will serve to supply the wash tank. These pumps will be located in the basement of the coagulant house. Although, very frequently, wash tanks are supplied in steam-operated plants by bleeding from high-service mains, it will be readily apparent that where electric power is used throughout for all pumping, as is the case with the new Wheeling pumping station, economy would dictate the installation of separate pumps to supply the wash tank. Fig. 2 is a cross-section through the head house showing the chemical and wash-water features.

Hydraulically-controlled plug valves for use with settling basin drains are not new but their use is still sufficiently recent to mark the occasion of their installation. They will be controlled by means of four-way cocks mounted on slate panel boards located in the mixing chamber and coagulant house. The floors are sloped 5 per cent to the drain valves, of which there are six in each basin and two each in the mixing chamber and

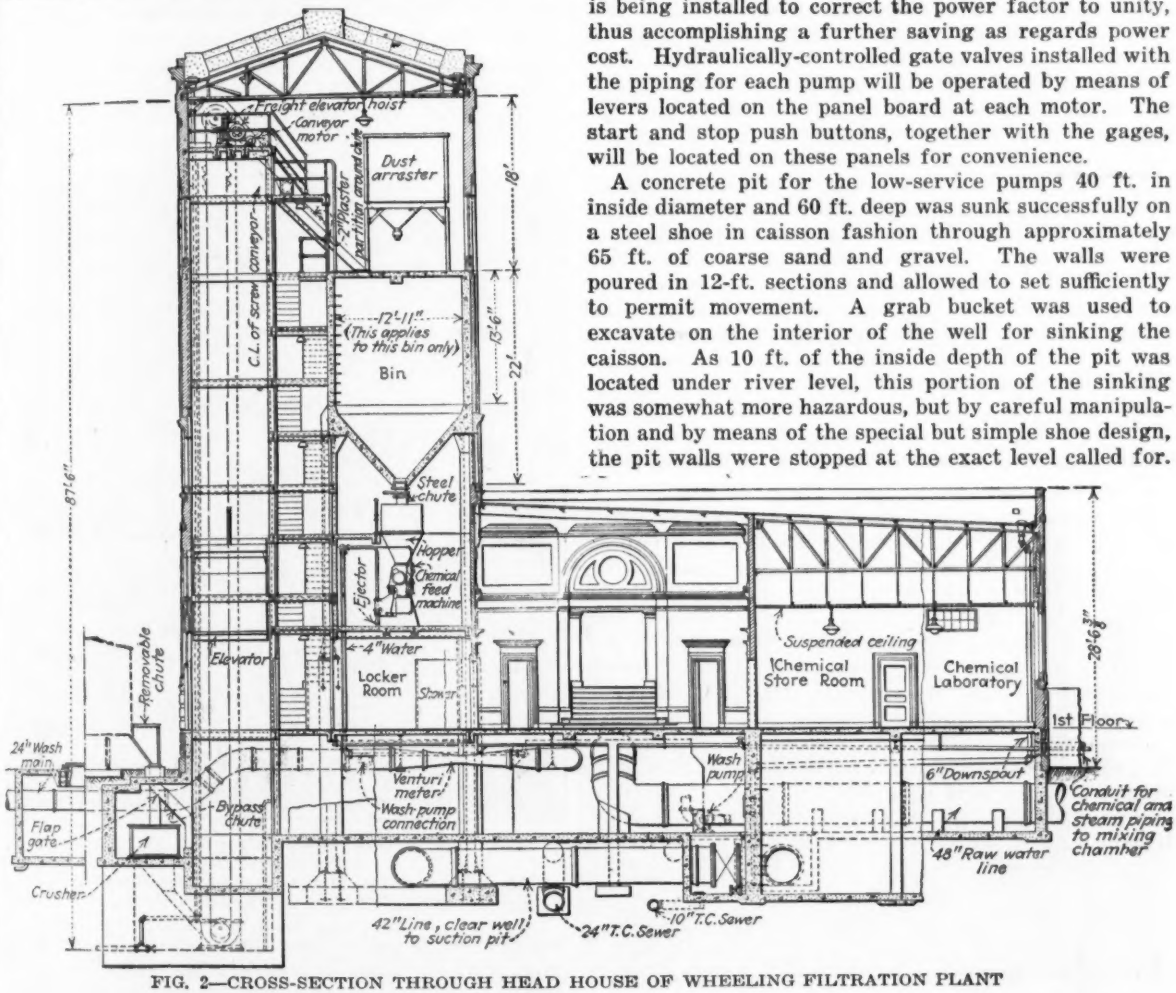


FIG. 2—CROSS-SECTION THROUGH HEAD HOUSE OF WHEELING FILTRATION PLANT

grit chamber. The pressure lines are located under water and extend through underground conduits between buildings to keep them from freezing.

The adoption of electric power for all pumping purposes in a water-works located in the heart of the coal regions, and with an expected annual power consumption of over 10,000,000 kw.-hr. is a distinct innovation. It was made possible primarily by the necessity for the construction of a new pumping station and a filtration plant and the abandonment of the present steam pumping station, thus reducing labor operating costs and the fixed charges on the first cost of the electric station to a point where it became a matter of choice only. Current will be furnished by the Wheeling Electric Co. on a special municipal tariff. Continuity of service will be practically assured by the installation of two power lines leading into the pumping station and supplied with power from three major sources, including the Beech Bottom power plant with a capacity of 180,000 kilowatt-hours.

The pumping machinery consists of a 10-, 15- and 20-m.g.d. pump for each of the services, high and low, automatically operated by means of push buttons located at the motors and on the switchboard panels. The motors are constant-speed induction, designed for 2,300 volts, 3-phase, 60-cycle. A synchronous condenser is being installed to correct the power factor to unity, thus accomplishing a further saving as regards power cost. Hydraulically-controlled gate valves installed with the piping for each pump will be operated by means of levers located on the panel board at each motor. The start and stop push buttons, together with the gages, will be located on these panels for convenience.

A concrete pit for the low-service pumps 40 ft. in inside diameter and 60 ft. deep was sunk successfully on a steel shoe in caisson fashion through approximately 65 ft. of coarse sand and gravel. The walls were poured in 12-ft. sections and allowed to set sufficiently to permit movement. A grab bucket was used to excavate on the interior of the well for sinking the caisson. As 10 ft. of the inside depth of the pit was located under river level, this portion of the sinking was somewhat more hazardous, but by careful manipulation and by means of the special but simple shoe design, the pit walls were stopped at the exact level called for.

The bottom ring was designed against hanging, during sinking, on two points diametrically opposite, with each half of the ring figured as an overhang. This is cared for by two rows of reinforcing steel in the top and extra steel in the bottom of this ring. The bottom of the ring was also reinforced circumferentially to resist the horizontal component of the upward thrust on the floor at the highest known flood which is El. 663 or 46.5 ft. above the floor. No difficulties were experienced during the sinking process although at one time the walls were 3¾ in. out of plumb in one direction and 2 in. in the other. The final results show that the walls in one direction are exactly plumb but 2¾ in. off of the starting location horizontally and leaning over 1¾ in. at the top but in the exact horizontal starting position at the bottom in the opposite direction. Slight cracks were perceptible during the last stages of the sinking operation at the quadrant points

in the top walls, extending to a point about half way down in the ring next to the bottom. These cracks were undoubtedly caused by the unbalanced forces which made the pit lean, but they cannot be found since the final adjustment of conditions. A recent flood stage of unusual heights, approaching within 10 ft. of the highest known flood and producing a head of 36.5 ft. at the floor line, put a severe test on the newly constructed pit but only one leak developed. This was in the sump well in the bottom of the pit where the concrete is but 2 ft. thick. This will be grouted to absolute watertightness.

A design of the shoe ring was made by the engineers but was modified slightly by the contractor to meet his assumed conditions of construction. A view of the first ring just as sinking operations started is shown by Fig. 4 (taken from top of 165-ft. concreting tower).

Five 1-m.g.d. covered steel tanks are being installed as additional reservoir capacity, to be located some distance away from the present masonry reservoir. (See *Engineering News-Record*, Feb. 7, p. 229.)

The negotiation and purchase of the private water-works supplying the suburbs were conducted by the consulting engineers in conjunction with the city manager. Three of the plants were completely appraised and the purchase made at the engineers' appraised value. The appraisals were developed on the basis of fair value and worth to the city, which eliminated from consideration the four pumping plants and sources of supply and three of the four reservoirs owned by these utilities. The city unquestionably was in a most advantageous position to negotiate inasmuch as the statutes of West Virginia prohibited the granting of exclusive franchises and thus permitted others to parallel the utilities' mains in competition if they saw fit to do so. The fourth private water-works was actually donated to the city in lieu of its assuming immediately the responsibilities of supplying the consumers.

Unification of the five water systems, four acquired by purchase or grant, was accomplished without difficulty. Under unified operation, all parts of the city will be supplied from the new pumping station, filtration plant and present new reservoirs, thus reducing the present cost of operating plants separately. The largest of the private plants operates, through necessity, two separate supplies, one at each end of the system to restore lost friction head, and add to the supply. These supplies are five miles apart with a single 8-in. main extending most of this distance and supplying the territory between. By the installation of a 16-in. main it will be possible to supply the furthermost of this territory from the new and old Wheeling reservoirs, which are 100 ft. lower than the main reservoir of the private plant. It is expected to construct a booster station to supply a few houses too high for the new conditions. Approximately 21,300 ft. of 31-in. steel rising mains, 20,000 ft. of 16-in. cast-iron main, 5,000 ft. of 12-, 6,000 ft. of 10-, and 10,000 ft. of 8- and 6-in. mains,

FIG. 4—SINKING THE FIRST RING OF THE PUMP PIT FOUNDATIONS
Coagulant house foundations and also foundations for part of filter house show at the front of the pit.

besides several major cross connections of 20- and 30-in. pipe, were necessary to complete the unification of the water-works system and connect the present system with the new pumping station and filtration plant.

Contracts totaled $1,666,903, of which $1,170,000 had been completed on April 1. The important divisions are:

Railroad siding	$3,000
Intake works (pier, line and tunnel)	84,350
Pumping station, machine shop, etc.	283,558
Filtration plant	567,000
Force mains, extensions, cross connections, etc.	590,625
Reservoirs	138,370
Total	$1,666,903

Three of the private plants were purchased for $278,993 and the fourth for $266.

John F. Casey Co., Pittsburgh, is contractor on the substructure; Engstrom & Co., Wheeling, on the superstructure; and Pittsburgh DesMoines Steel Co., Pittsburgh, on reservoirs and pipe lines. Eleven other contracts cover filter equipment, elevators, crane, conveying apparatus, pumps, and material. It is expected that the improvements will be completed by next September

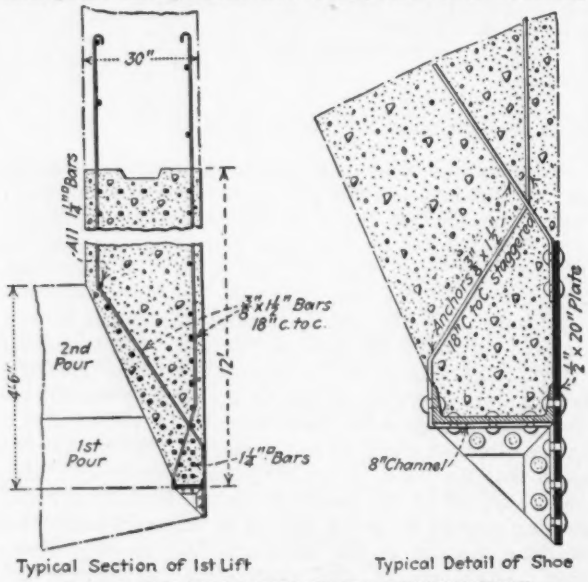


FIG. 3—DETAILS OF PUMP PIT CAISSON-SHOE

Welding Field Joints and Laying Riveted Steel Pipe

After Welding, Spring Valley Water Co. Lowers Line by Tripods on Level and Cribs on Slope Over 5 Per cent

By George W. Pracy
Superintendent City Distributing System, Spring Valley Water Co., San Francisco, Calif.

About four years ago the Spring Valley Water Co. laid a line of 22-in. riveted steel pipe in which all the field joints were welded. This type of joint was decided upon in an attempt to get a joint that would be cheaper than the riveted joint or the lead joint. The result was so satisfactory that welded joints have

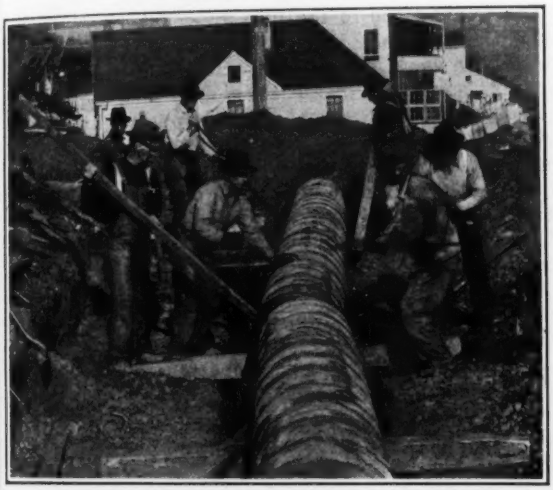


FIG. 1—LINING-UP CREW AT WORK WITH 24-IN. PIPE
Crew consists of six men and foreman. Pipe lengths are left ¼ to ½ in. apart to allow for "take-up" incidental to welding.

since been used in all installations of steel pipe lines. These joints have been used on 22-, 24- and 30-in., riveted pipe, all made from ⅜-in. plates, and on 16-in. pipe made of sheets of No. 10 steel.

All pipe is ordered the same as for riveted field joints except that on both ends of each length the rivet holes are omitted and the plates are beveled 45 deg. on what will be the outside of the pipe. The pipe is made in lengths of approximately 30 ft., which in all but one job consist of three inside and two outside courses, an inside course being on each end. On the other job each length consisted of six courses, so that an outside course was on one end and an inside course on the other. This made no difference except that it was not so convenient as about half of the lengths had to be turned around to fit.

The pipe is unloaded from the cars, hauled to the job and unloaded along the ditch the same as usual. Pine timbers 6x6 in. are laid across the ditch and the five or six lengths to make up a section are rolled onto them and lined up, the ends being left from ⅛ to ¼ in. apart. This lining up is done by blocking up the timbers and shifting the pipe. When each piece is in adjustment it is blocked in place. The next section is then lined up, although it need not be and very seldom is in line with the preceding section. Seven or eight men are used in lining up the pipe on the larger sizes; three or four men can line up the 16-in. pipe. In our work, we always keep the rivets in the straight seams within a foot of the top of the pipe. A welder follows and tacks the ends together; that is, he welds them in four or five spots around the pipe. He has a helper with him who, by means of spuds, pries the circumference of the pipe into exact position to weld, the pipe being not always exactly circular. Then welders, who work in pairs, complete the welding of the joint. The top half (as a matter of fact about three-quarters of the joint) is welded, the pipe rolled over and the joint completed. The joints are then painted or wrapped and the section is ready for the ditch.

The laying gang comes next accompanied by another welder. They have with them three tripods, made of 4x4-in. x 14-ft. Oregon pine, three chain tackles of 1, 1½ or 2 tons, depending on the weight of the pipe, and three slings. These slings are made of about 1¼-in. hemp rope of proper length, the ends spliced to form a ring. The tripods are set up, one over the center and one about one-sixth of the pipe section length or about one length of pipe from each end. The chain blocks are hung on the tripods, the rope slings slipped under the pipe double, one double end slipped through the loop of the other end and hung on the chain blocks. Working the three blocks simultaneously, the pipe is lowered onto timbers in the bottom of the ditch, landing a foot more or less away from the previous section. The slings are then slipped back a distance equal to that between the two sections, and as the strain is again taken by the chain blocks the pipe

FIG. 2—OXYACETYLENE WELDING OF 22-IN. PIPE
Iron framework covered with cloth serves as windbreak.

slides forward into its proper position. If the pipe lands so far away that the ends cannot be brought together in one movement of the slings, the operation is repeated as many times as is necessary. Where there is an obstruction across the ditch that cannot be removed, the pipe is lowered on one side of the obstruction and then slid along under it into place. It may be better to lay short sections to avoid moving the pipe through too great a distance. It is not advisable to move the pipe too far at one setup of the slings as excessive dragging injures the coating when it is moved more than 2 ft. After the pipe has been slid lengthwise the proper distance, the timbers are taken out from under the pipe and the section is lowered and held in place while the two ends are tacked, the welder finishing the joint while the laying crew go ahead to the next section. Just before final lowering of the pipe, grooves are dug

in the ground under the slings so that they can be removed. On the 16-in. pipe, the joints in the ditch were not welded but were made with a wrought-iron sleeve, using cement as a filler, as will be explained later.

In laying out the line, so far as can be done, we make the tangents in multiples of lengths, so that the bends come at the ends of the sections. To do this, where the line is crooked, we had to lay sections consisting of four, three or two lengths and in one line for some distance we made an angle at every length. These angles are always figured in advance and a paper templet is made up giving the exact amount that must be cut off each end to make the proper bend. This amount is cut off when the sections are made up and the two ends are fitted together the same as the straight pipe. Where it becomes necessary to make a bend at a point other than at the end of a section, this joint is made at the end of some length.

In some cases we have had to make the bend in the middle of the length. To do this we cut a section of the

FIG. 3—LOWERING 180-FT. SECTION INTO TRENCH
This section consists of six 30-ft. lengths of 24-in. pipe welded together. Note tripods used in lowering. Welding of bends as shown in foreground is delayed until just before lowering to permit of last-minute changes.

proper size, as given by our templets, out of the length of pipe at the correct distance from one end. This is a wedge-shaped piece, varying from no thickness to the thickness necessary for the proper angle. The cut is not made clear around the pipe, there being about an inch of metal left where the two cuts meet. On our work, care is taken to make this cut so that the rivets are left on the top of the pipe. A block and tackle is then hooked onto the outer ends of the pipe and enough pull is given to draw the edges of the cut together so that they can be welded. Angles up to 22 and 23 deg. are made in one cut. If greater than that, the total angle is made up of two or more smaller angles, the cuts being made from 1 to 2 ft. apart, depending on the angle. No fixed rule has been adhered to, the cuts sometimes being several feet apart.

A bend of this type can be made in from two to four hours by two men. As the pipe is laid in the ditch, the distances are checked, the bend being made up at the latest possible moment, when the exact point where the cut or cuts should come is known. In some cases, where the bend is not too great, it is incorporated into a section. In other cases it is laid by itself. At first we made the bends in our shop using pieces of pipe as before but not whole lengths of pipe. The greater convenience of making them in the field, including them in a whole length of pipe, caused us to give up the shop work. With the present methods a change in the location of the line can be made up to the last moment without interfering with the work.

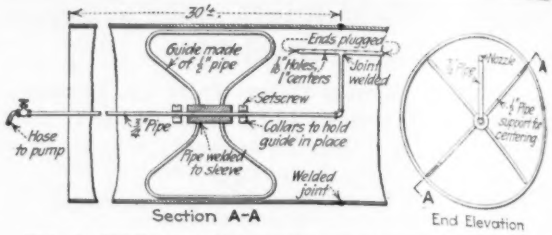


FIG. 5—SIDE AND END VIEW OF PAINTING MACHINE FOR COATING INSIDE OF JOINTS

The joints made in the field are painted both inside and out. For pipe 22 in. and larger, a man can go inside and do the work, even to the extent of going through the six lengths to paint the joints made when the sections are put together. For the 16-in. pipe this is not practicable. To get these joints painted, a painting machine was developed consisting of a piece of ¾-in. pipe about 34 ft. long. On the front end of this pipe was a 90-deg. elbow and a 6-in. nipple. On the end of this nipple, and at right angles to it and parallel to the long piece of pipe was welded another nipple about 8 in. long with both ends dipped. In this last nipple were drilled ⅛-in. holes on 1-in. centers.

To keep the ¾-in. pipe centered in the 16-in. pipe, a yoke was constructed of small pipe which was fastened, by means of collars, about one foot from the nozzle, leaving the machine free to rotate. On the rear end of the pipe, connected through a hose, was a hand pump with an air chamber, the section being inserted into a can of paint or pipe dip. A valve was placed on the end of the ¾-in. pipe just ahead of the hose from the pump. The painting machine was run inside the pipe, measurement being taken to get the nozzle opposite the joint. The pump was operated and when a pressure of about 125 lb. was reached the valve was opened and the pipe was rotated, which gave a good coating to the joint. Before using the apparatus considerable experimenting was done until we were satisfied that the joints were well painted.

At first, we had some trouble on account of the small holes clogging. This, however, was eliminated by sticking ordinary round toothpicks into the holes after each joint was painted, the toothpicks being left in until the machine was again used.

All welding was done by oxyacetylene apparatus. Soft Swedish iron rods ⅛ in. in diameter were used on all jobs. On the No. 10 sheets ¼-in. rods were first used but they were not as satisfactory as the larger rod. The welding was done in accordance with standard welding practice. The ends of all joints were kept apart to allow for expansion and contraction. The welds were made twice the thickness of the plates. The weld was carried back along the straight seam to a point opposite the first rivet. The straight seam was then brazed to a point opposite the second rivet, using a very soft brazing wire. This brazing was done at a much lower temperature than the welding and made the seam tight without causing any warping or introducing strains in the riveted joint. If the brass cracks in cooling it can be calked into place. Where the lap on the straight seams makes a double thickness of plate, both

thicknesses are heated and brought together and welded to the single plate of the next length. In making the welds in the ditch a hole must be dug on each side of the joint so that a man can lie on his right side and weld the bottom of the joint. A hole must also be dug under each joint, 18 to 24 in. wide and 12 to 15 in. deep.

The first 16-in. pipe we laid was put together on top of the ditch in one continuous piece and lowered into the ditch as we progressed. The long bend formed in the pipe which follows along the pipe as it is laid in this manner puts the rivets under a strain. We had enough trouble with leaky seams in this line to make us lay the next 16-in. pipe in straight lengths, which have given no trouble.

outlet is that it can, if necessary, be taken off horizontally at any point on the pipe.

After four years' use of welded joints we are well satisfied. Under our conditions, they are the cheapest. Only one joint pulled apart, due to settling ground. On most of our work we can get the welders from among our regular crew, doing away with the grief that comes from temporary employees. Welded joints make the job very flexible. Obstacles can be avoided as they are met at a minimum cost and with no delay. If for any reason it becomes necessary to alter the length of a piece of pipe, it can readily be done, either by cutting a piece off or welding a piece on. There is one thing that must be borne in mind, however, and

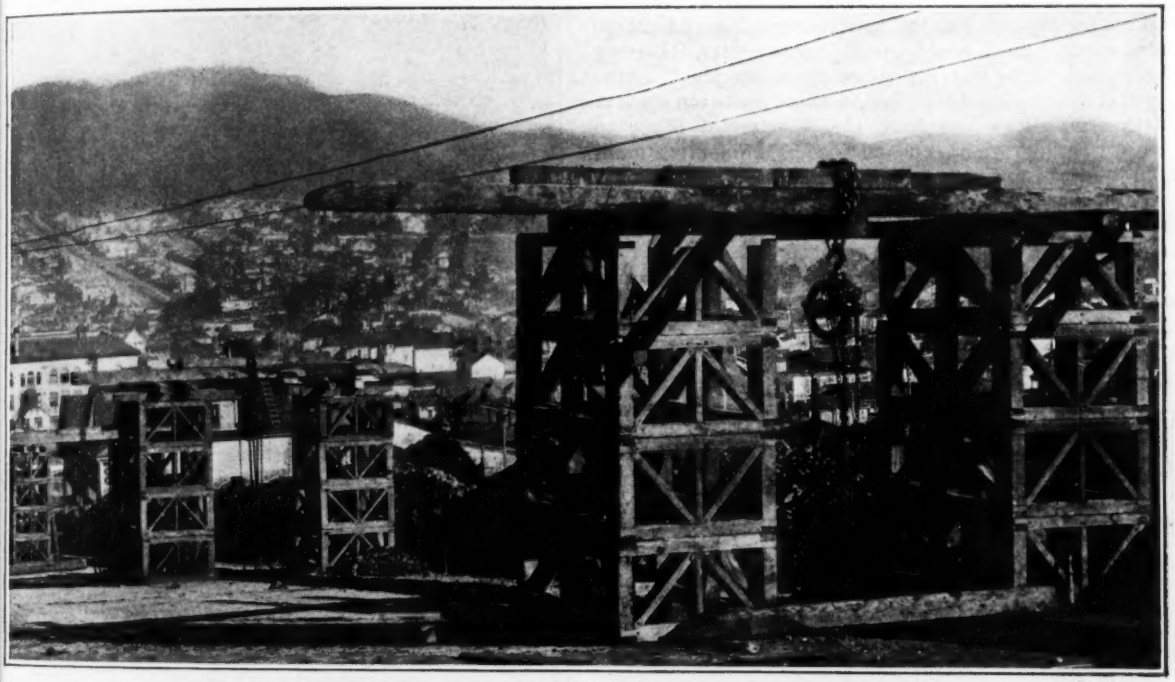


FIG. 4—HOUSE-MOVERS' CRIBS SUBSTITUTED FOR TRIPODS ON SLOPE
Where the grade exceeds 5 per cent there is enough thrust in a downhill direction to threaten the safety of the tripods and therefore cribs are used as shown.

In addition to the welding of the joints, all outlets for air valves, blowoffs and pipe connections are welded to the pipe. Pieces of standard screw pipe about 8 in. long are used. One end is threaded, a flange being screwed on before the pipe is welded. At first the outlets were welded on without the flanges but the pipe warped just enough to make the flanges go on very hard. Since we have screwed the flanges on first we have had no trouble. To make the hole to be cut from the pipe and also to mark the end of the pipe so that it can be cut to fit the big pipe, we have a wooden templet made. This templet is about 12 in. square and 6 in. thick and has one side cut to fit the large pipe. A hole with a diameter slightly larger than the outside diameter of the outlet pipe is cut through the center of the templet. To mark the big pipe, the curved surface is put against the pipe and a piece of chalk run around the inside circumference of the hole. To make the outlet pipe, it is slipped through the hole in the templet and a chalk mark made around the intersection of the pipe and the curved surface.

The wooden templets last a long time and are big enough not to be lost. One advantage of the welded that is that reliable welders must be on the job. A poor weld cannot be detected, once it is made.

Welding on the Spring Valley system is under the direction of Roy Tullis, who has developed a number of the methods and devices described in this article. The work was done under the general direction of P. D. Rice, general foreman, Spring Valley Water Co.

Advertising a Water Supply

By actual count water faucets were opened 152 times per day in a modern home in Indianapolis. With this count and an enumeration of seventeen uses from cooking to sprinkling coal and changing the water in the gold fish bowl, a very creditable three-column advertisement 12 in. long was devised by the local water company to apprise patrons of just how dependent on the water utility they really were. Educational advertisements of a similar nature are run each Tuesday and an arrangement has been made with the school teachers whereby the pupils can find in the advertisements answers to questions on the water system. A better appreciation of what the water utility means without waiting for a shut down to show them is the objective.

Laying Large Water Main Through Swamps in New Orleans

Mules Haul Pipe on Eight-Wheel Wagons—Clamshell Lifts Wedge of Roots Cut by Steel Sheeting—Piles Hold Bends—Tapping Machine Brought To Job for Special Connection

By John T. Eastwood
Principal Assistant Engineer, Sewers and Water, Sewerage and Water Board, New Orleans, La.

UNSTABLE ground conditions through which a length of more than three miles of large-size cast-iron main was recently laid in New Orleans presented difficulties of delivery, trenching, laying and subsequent maintenance seldom met in other cities. The work was in progress from the fall of 1920 to the spring of 1923 but the new construction did not go into service until early in the past winter. During the period while this main line from the plant to the general system was being laid, a 48-in. cast-iron class A suction pipe was laid from the Mississippi River to the purification plant, and on top of the suction main a 20-in. cast-iron mud discharge line was placed.

For several years, owing to a lack of funds, the nominal 40-m.g.d. capacity of the purification plant has been exceeded by 5 m.g.d. with days and hours of greater peak load. In consequence it was necessary to work to the limit for hours to keep up the supply. The old 48-in. cast-iron suction line, built in 1906, 1907 and 1908, has in former years delivered up to 55 m.g.d., at low-water stage of the river, but in later years this fell to a maximum of 47 m.g.d. This meant an increase of risk, a serious responsibility for the engineers. It became necessary, therefore, to built the new line in compliance with the requirements of the National Board of Underwriters, and also the growing needs of the city. This new line was in the original plans and its river end—from the intake crib to the inside toe of the levee—was laid in 1908. The new line was laid from the toe of the levee, 3,600 ft., to the pumping station. It delivered, upon completion, 60 m.g.d., as was expected. This delivery is through the same size of pipe, same length, same grade and other considerations as the old line, through which the delivery had been reduced to 47 m.g.d.

FIG. 1—LAYING 43.31-IN. MAIN ACROSS DRAINAGE CANAL ON LEONIDAS ST.

Pipe is laid on piles and strapped down to them. Roots and stumps make up 60 per cent of the excavation cut into wedge by the steel sheeting. Stream of water played continually on bucket.

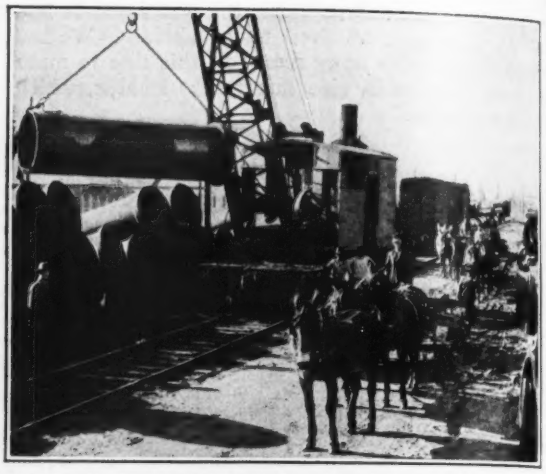


FIG. 2—THREE-MULE TRAINS WITH FIVE EIGHT-WHEEL WAGONS DELIVERED THE PIPE

Crane unloaded 9,000-lb. pipe from cars and reloaded to log wagons. Frequently it was necessary to transfer pipe from a mired wagon to an empty one drawn up alongside.

The 20-in. mud line was placed at the same time as the suction line, in the same trench, on 8-in. cypress saddles resting on the larger main, both lines being laid level. It is used to discharge mud from the settling and coagulation basins to the river, and terminates 200 ft. downstream from the intake crib. This method of disposal of the mud was in the original plans, but for years the mud was either pumped on land held by the board for future extension of the purification plant, or was sold for filling. The cost of handling and hauling became prohibitive, hence the building of the mud line.

The plans for the main delivery line called for 17,800 ft. of 42-in. Class B pipe. The pipe used was 43.31-in. and 41.34-in. Class C pipe, which had been made for the Argentine government for use in Buenos Aires. The reason for the odd size was that the pipe was made to metrical measurements, being 1.1 and 1.05 meters in diameter. It was uniform in thickness, cut off on the spigot end and banded on both ends, each pipe being 13 ft. 1½ in. in length.

The work required approximately 100 men with one 20-ton locomotive crane, two 40-ft. pile drivers, one with steam hammer driving steel sheeting ahead of the digging and the other pulling this sheeting. The

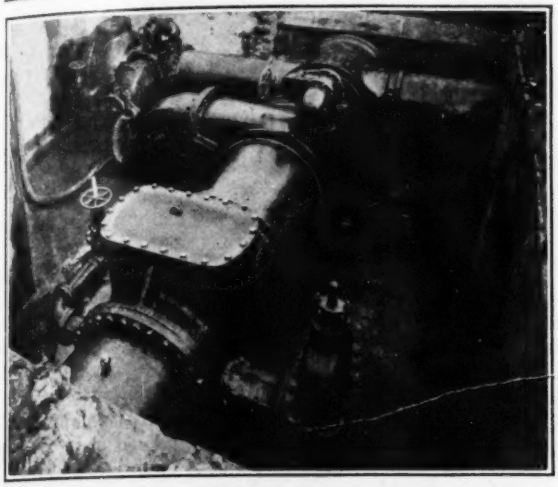


FIG. 3—UNUSUALLY COMPLICATED LAYOUT OF SPECIALS AT JUNCTION OF 30-IN. WITH 42-IN. MAIN

One of 30-in. branches from new large-size pipe connected to existing 42x30-in. cross in 42-in. line. A 56-in. check valve and 42-in. valve were cut in old 42-in. main while the main was drained. This was considered a model piece of special work.

sheeting was transferred from the rear to the front on a 36-in.-gage industrial track, by a gas locomotive with 4-ton cars. The steel sheeting was 24 ft., 16 ft. and 12 ft. in length, driven so that the 24-ft. sheeting would carry the 12x12-in. cribbing that supported the 20-ton crane. The amount of sheeting used covered about 600 ft. of trench, enough to balance the head driver and rear puller, so that the whole work would keep in uniform step when laying six to eight pipes a day.

The digger, a 20-ton crane, straddling the 18-ft. trench, was used to excavate and grade the trench, lay the pipe (weight 9,000 lb. each), backfill and crib as the work progressed. Two sections of standard gage track, 30 ft. long, were used under the crane, the sections being made rigid so that they could be transferred ahead of the crane. The trench for the 48-in. suction line ran from 12 ft. to 16 ft. deep and

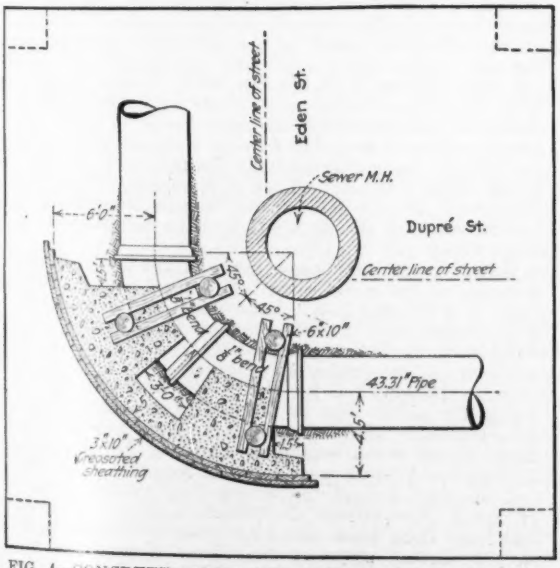


FIG. 4—CONCRETE PILES AND SHEETING HOLD BENDS AT STREET CROSSING NEAR MANHOLE

8 ft. wide. The trench for the 43.31-in. and 41.34-in. main delivery line ran from 8 ft. to 12 ft. deep and 8 ft. wide.

The use of steel sheeting for the trench made it possible to cut out a solid wedge of roots and stumps, which were encountered in a veritable mass at all times. The wedge of the stumps could then be lifted, broken and excavated by the crane, which was equipped with a ¾-yd. clamshell bucket having seven teeth. The teeth were absolutely necessary in order to get a bite on the cypress stumps.

The pipe was laid on established grades with blow-offs at predetermined points to blow the line in case of trouble. This is a big item when the size and quantity of water to be pumped between valves is considered. The blow-offs lead into the drainage canals. The pipe is laid on a double 2-in. No. 2 cypress cribbing, in order to give the heavy pipe a general and stable foundation until the backfilling and excavation have suffi-

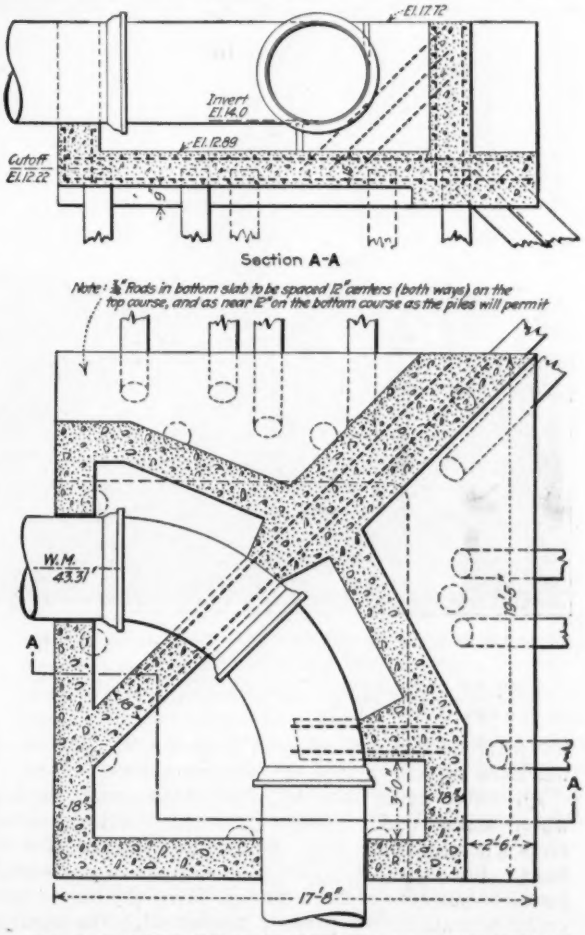


FIG. 5—BATTER PILES EMBEDDED IN CONCRETE OF MANHOLE STRUCTURE HOLD BEND IN SOFT EARTH

ciently solidified to hold the line. The joints were calked with dry hemp and lead and driven by hand; about twenty minutes were consumed to a joint.

One of the difficulties to be overcome was the placing of the pipe ahead of the work, since the location of the discharge main for its greatest length was through undeveloped areas, without streets or drainage, and over soil that at times would not carry a mule's weight.

This hauling was accomplished by the use of five log wagons having eight wheels with 9-in. tires. Three to four mules were hitched to each wagon. It would have been a serious and costly problem if it had not been for these wagons; they carried one 9,000-lb. pipe at a time. When one became stalled, an empty wagon was placed alongside and the pipe transferred. This shifting was a frequent occurrence.

It was considered safer to connect the new 43.31-in.—41.34-in. line to the old 42-in. line at Claiborne Ave. and Calliope St., by means of two 30-in. lines, rather than by one 42-in. connection. One of these ties had to be made while the old main was under pressure and delivering full supply to the city. The other 30-in. branch was connected with an existing 42x30-in. cross after shutting down the old line.

A No. 4, 30-in. tapping machine rented from the A. P. Smith Manufacturing Co. was used with great success to make the tie. Although it required three days to accomplish the job, the actual cutting time, after

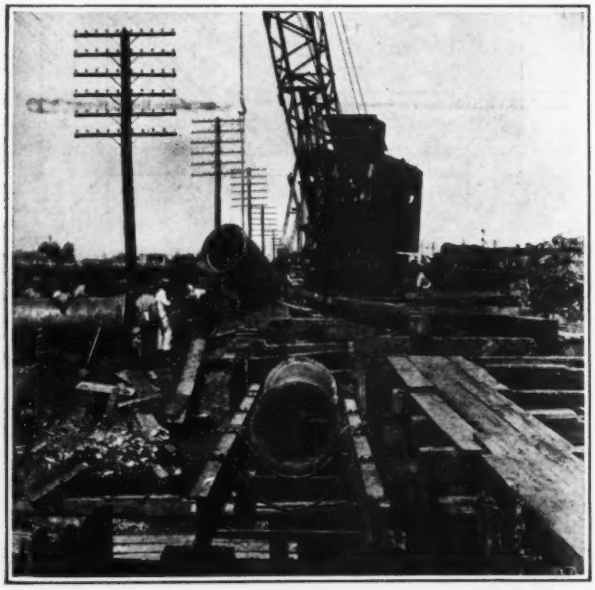


FIG. 6—LAYING METER SIZE PIPE OVER WOOD DRAINAGE CANAL

Canal on Broad St. at Calliope was spanned by two 20-in. I-beams strapped against upward and downward pressure. The I-beams rest on piles.

the machine was set up, was four hours. The work was done entirely by the board's own forces.

All water-works men know what to expect in big water mains under 100-lb. pressure when deviating from a straight line, even as little as a one-sixty-fourth bend. But when it comes to holding two one-eighth bends in place, to make a 90-deg. turn, one has to take every precaution to prevent movement. On account of unstable soil, our plan was to drive creosote piles in bents at proper intervals, together with auxiliary piles for bracing, these piles projecting above the pipe and braced. In addition, a double set of 3x10-in. sheeting was driven on the outside of the curve to act as a brace and control the resultant thrust. The space between the pipe and sheeting was filled with concrete. At Fig and Leonidas Sts., where we turned a right angle, this line blew out under a test of 70 lb. and, because of the instability of the soil and the vibration of the trains sounthbound on the main line of the Illinois Central R.R., 100 ft. distant, this method could not be depended upon. So additional piles were driven on a batter, all piles being cut off to grade and capped with reinforced concrete, as shown in the drawing. This method was successful, as no movement was shown on the second pressure test of 100 lb. per square inch.

Continuous employment by the Sewerage and Water Board of its engineers and foremen and, to a large extent, of its laborers, renders it practicable and extremely economical to undertake such work as that described without recourse to outside help of any kind other than additions to the number of laborers. The approximate cost of the three lines was $800,000. Alexander Allison, Jr., office engineer, had charge of the design and details; E. A. Fowler, assistant engineer in the Water Maintenance and Construction Department, was in charge of construction in the field, and R. L. Atkinson was assistant engineer for locations, grades and estimates. The writer, as principal assistant engineer, was in general charge and the engineering operations of the board, as a whole, are under the direction of George G. Earl, chief engineer.

Snow Survey in Nevada Forecasts Light Stream Runoff for 1924

REDUCED stream flow in Nevada was predicted for the present spring and summer owing to the light snow cover of the past winter, according to the April forecast of J. E. Church, Jr., in charge of the snow survey system conducted jointly by the state of Nevada and the U. S. Weather Bureau. This condition is the reverse of the previous season, the snow cover being only from 41.4 to 55.1 per cent of normal, as compared with 92 to 99.4 per cent for the winter of 1922-23 as noted in *Engineering News-Record*, June 7, 1923, p. 1001. A brief summary of Mr. Church's detailed forecast report for 1924 is given below:

The snow cover in the Central Sierra quadrangle varies along the crest of the Sierras from 41.4 per cent in the Yuba-Truckee basins to 55.1 per cent in the Stanislaus-Tuolumne-Walker basins. However, the relatively light snow cover at lower elevations on the eastern slope requires a correction downward in the following estimated runoffs for the various basins: Truckee (exclusive of Tahoe), 42.1 per cent; Tahoe, 47.6; Carson, 48.5; Walker, 42.6; Yuba, 45.1; American-Tuolumne, 55.7 per cent. Owing to scant snow at low elevations, the snow cover in the Humboldt Quadrangle will probably furnish a runoff of only 72.4 per cent in the main Humboldt at Palisade and 50.1 per cent in the Little Humboldt. Lack of precipitation during April-June may cause a still further maximum reduction of 25 per cent in the runoff in all streams and 50 per cent in Lake Tahoe.

Owing to the high snow line and the low seasonal percentage of the snow cover, the runoff will be unusually light in April and July. Lake Tahoe will probably rise to a maximum level of 6,225.55 ft., but will probably fall to 6,224.43 ft. by Oct. 1 and possibly to 6,223.68 ft. at winter minimum. Navigation at wharves will be more difficult than in 1919-20 and by Oct. 1 the available draft from Tahoe for power may be reduced to less than 100 sec.-ft. The minimum level of record is 6,223.05, October, 1889, when Tahoe outlet was dry. However, the dry years of 1888-89 and 1911-13 were followed by years of record rise.

Even with normal temperature, an uneven distribution of runoff is inevitable the present season. Owing to the relatively light snow cover at lower elevations, especially on the eastern slope of the Sierra Nevada and in the Humboldt basin, and to the high snow line, only scant

runoff may be expected in April. Likewise, the low percentage of snow cover even at high elevations will cause an extremely low flow in July. Only summer and autumn rains can maintain the flow even at seasonal stage.

If the precipitation in the Central Sierra during April-June is unusually heavy, the shrinkage may be slightly reduced. On the other hand, the runoff in all basins may be still further depleted if less than normal precipitation falls during this period. Although dry summers do not usually follow winters of scanty snowfall, the scant precipitation during the first half of the present April reduces somewhat the chance of obtaining super-normal precipitation for the period.

New Process of Garbage Disposal at Lebanon, Pa.

After Being Ground in Bone Mill, Material Will Be Sent Two Miles Through Sewer to Imhoff Tanks

By Dr. Clarence R. Fox and William S. Davis
City Chemist and City Engineer, Respectively, Lebanon, Pa.

GARBAGE disposal experiments on a small scale conducted by the writers on behalf of the city of Lebanon, Pa., having given satisfactory results, the authorities have decided to dispose of the garbage of the city by grinding it, discharging it through the outfall sewer and into the Imhoff tanks which constitute a part of the sewage-works of the city.

The population of Lebanon by the census of 1920 was 24,643. Garbage and ashes thus far have been collected by private scavengers who charge individual householders some 15c. a week, or about $7.80 a year for the service. The material thus collected is disposed of by dumping, the ashes being used as far as feasible for covering the garbage but not always being sufficient for that purpose. Smoldering fires on the dumps cause objectionable smoke and odors.

An ordinance establishing a municipal system of collection and providing rules and regulations for separation of the garbage and ashes is before the City Council (April 22). It is estimated that the garbage can be collected by the city and hauled to a grinding plant located about seven blocks from the center square of the city at a cost of $2.50 to $3 a ton, and that the grinding of the garbage preparatory to its being conveyed by the sewer to the Imhoff tanks will bring the total cost up to not over $4 for both collection and disposal. It is assumed that the amount of garbage collected will be 10 to 12 tons a day. The volume of sewage treated at the sewage-works is some 2 m.g.d. or about 8,000 tons, of which some 0.2 per cent is solids. As 75 to 80 per cent of the garbage is water, the addition of 10 to 12 tons of garbage a day to the sewage will not materially increase the total solid matter flowing to the Imhoff tanks.

Lebanon has a separate system of sanitary sewers, discharging by gravity through a 30-in. outfall some 2½ miles long to the sewage-works. Here the sewage passes through grit chambers to Imhoff tanks. The tank effluent flows to a well, is pumped through a weir chamber and flows by gravity to dosing tanks which distribute it intermittently to sprinkling filters. The effluent is treated with a solution of chlorine gas at the rate of 10 lb. p.m.g. or 1.2 p.p.m., flows by gravity to secondary setting basins, and from these is discharged into Quittapahilla Creek.

Grinding the Garbage—Before starting our experiments we noticed that the sewage arriving at the treatment works contained some garbage, including cantaloupe and watermelon rinds, and that this material floated on the surface of the Imhoff tank. If it were not removed by scoops, then the floating garbage putrefied and gave off offensive odors.

We believed that by separating the garbage into finely divided particles before it entered the tank, the particles would settle and putrefy. Therefore, we built an experimental plant for grinding the garbage and passed the ground material through an iron chute into the supply channel of one of the Imhoff tanks. The ground garbage immediately settled and entered the sludge chamber of the tank. As soon as this was determined we felt that the garbage problem was solved, at least for Lebanon.

For grinding the garbage in the experimental plant use was made of an old lime crusher (a No. 7 shell mill designed for grinding clamshells or dry clay). This crusher consisted of a roll and fixed jaw, the roll having projections and recesses so as to give a shredding effect. The hopper had a 14x14-in. opening at the top and a 4x6-in. opening at the bottom. It was approximately 15 in. deep. The roller was 2½ in. in diameter. With one man feeding the mill, garbage would pass through at the rate of 500 lb. in 15 min. or a ton an hour. The roll of the crusher was kept from clogging by a ½-in. stream of water from a garden hose passed into the hopper with the garbage.

The plant for the disposal of all the garbage of the city will be located on a plot of ground approximately 0.2 acre in area in a building 40x40 ft. in plan, built of cement block and having a concrete floor. The hopper of the crusher will be level with the floor so the garbage truck can be dumped directly into the hopper. For a grinder a bone mill with a nominal capacity of 20 tons a day will be run by a 20-hp. motor.

A 10-ton incinerator would cost $25,000 to install and would be very expensive to operate, requiring much fuel and labor. It is estimated that the grinding plant, building and drain connecting the grinder with a manhole in the 30-in. outfall sewer will cost $5,000 to build and it can be operated by one man. An incinerator would have to be located outside the city, while this grinder plant will be located near the center of the city, thus saving materially on haulage.

The writers believe that this system of garbage disposal could be adopted by any city that has sewage-works, regardless of whether separate or combined sewers are in use, and that it is less expensive to install and operate than any other system. The writers have filed application for a patent on the process, dated July 28, 1923.

State Keeps Tab on Typhoid Carriers

Typhoid carriers of record within the State of New York increased from 86 to 108 during the year 1923 according to *Health News*, the weekly bulletin of the New York State Department of Health. The figures include 15 carriers in state hospitals at the beginning and 18 at the close of the year; and in addition, 4 died, 1 moved out of the state, 3 were returned to the list, and 21 new carriers were located. Of the 21 new carriers, 4 were working on dairy farms when located and 1 of these is held responsible for 25 cases of typhoid fever, and the remaining 20 for 44 cases.

Trials of Concrete Roadbed on Northern Pacific Ry.

Three Types of Concrete Slab Base Indicate Higher Maintenance Cost than That for Ordinary Ballasted Track Construction

EXPERIENCE with experimental track construction in which concrete slabs with wooden blocks or stringers take the place of the usual ties and ballast, on the Northern Pacific Ry., does not appear to encourage the idea of ultimate economy in the use of such "permanent" track construction.

In this experimental work, described in *Engineering News-Record*, Dec. 12, 1918, p. 1071, three types of track are employed: Type *A*, 594 ft., laid with slabs 8 ft. wide and having two troughs in which are placed rail blocks resting on shallow sills in order to provide a drain; Type *B*, 594 ft. with slabs 8½ ft. wide to allow a raised curb or guard on each side, the rails resting on two rows of wood blocks set in separate pockets with 3 in. of sand under the blocks; Type *C*, 810 ft. of 8-ft. slab, with raised curbs or guards inside the rails and with troughs for continuous timber stringers under the rails, the stringers resting on wood blocks embedded in the concrete. The first two types are on the eastbound main track between Nisqually and St. Clair, Wash., and the third type is on the adjacent westbound track. Type *A* is said to have proved the most satisfactory and economical.

After a service of 9½ years, with a traffic averaging nine to ten trains daily on each track, the 33-ft. slabs in type *B* show slight settlement, while in the other types, with slabs 16½ ft. long, the settlement is somewhat greater. No corrections have been made in the slabs, all adjustments for track surface being made in the rail supports. The first section at the east end of type *A* settled about 3 in., owing to being on a fill at the end of a cut. This section was removed in 1922. Slight inequalities of rail surface and line are corrected by shimming. When this method is inadequate to give a true surface, the cushion, tie sills, tie blocks and rail sills crush, check and become soft. It is then necessary to renew these parts.

As to surface and line of track, type *A* was in good condition for the first six years, since which time it has become somewhat rough. The original tie sills and tie blocks are in place, but conditions indicate that the timbers and outside cinder and gravel filling material should be renewed in the near future.

Type *B* was good for the first three years, but after that it gave trouble through being out of line and surface. In 1919 it was necessary to renew the asphalt cushion, tie sills and tie blocks, but in a short time the asphalt worked up out of place, so that the track was again in poor line and surface. To overcome this condition, changes were made in 1921 by removing the asphalt cushion, increasing the depth of tie sills, renewing tie blocks, providing drain holes at the tie pockets and sealing these pockets with self-sealing cement. Type *C* was in good condition for six years, but then became rough as the creosoted rail sill was crushing and splitting, its failure being hastened by considerable moisture collecting in the recesses. In 1922 these sills were renewed and were sealed in place with self-sealing cement.

Maintenance—Renewals of timber tie sills, tie blocks and rail sills and provision of better facilities for drainage have been the principal items of maintenance work. No rail failures have occurred on the concrete roadbed or on the adjacent ballasted track, but on the former the wear of rail heads is slightly greater and the battering of joints less than on the latter. On the concrete roadbed, light repairs are handled by the section gangs, but renewals and heavy repairs are done by the bridge and building forces. As to the riding of trains, all the three experimental types of track are more rigid than ballasted track and in this respect there is not much difference between the three types.

In annual maintenance cost, estimated on a one-mile basis and taking the adjacent ballasted track as 100, type *A* is 200; type *B*, 673 and type *C*, 391. This comparison is based on actual cost of work and materials, but the ballasted track will soon require reballasting. Type *A* also will require extensive repairs in the near future. For renewals of parts, independent of the concrete slab, type *B* should have a life of about three years and type *C* about six years. On the basis of maintaining expenditures incurred on these short sections of concrete construction, the extended maintenance costs per mile of the three types of concrete roadbed compare with standard ballast roadbed as follows: Track on ties and ballast, $610; concrete base track, type *A*, $1,225; type *B*, $4,108; type *C*, $2,386. With a substantial mileage of the concrete roadbed, instead of a few hundred feet in length, the results might be different, but it is considered that this difference would not be sufficient to justify the construction of any of the three types of concrete roadbed.

Developed and Potential Water Power of the United States, 1924

DEVELOPED water power in the United States has now reached a total installed capacity of 9,086,958 hp., or an increase of nearly 15 per cent over the 1921 figures, according to the U. S. Geological Survey. Of this total, 81 per cent is installed in public utility plants and 19 per cent in manufacturing plants. New York State, with 1,542,983 hp., is still the leading state; California, with 1,451,830 hp., is second; Washington, with 480,356 hp., is third; Maine, with 473,188 hp., is fourth; and North Carolina, with 431,500 hp., is fifth, displacing Montana which ranked fifth in 1921.

Estimates of the potential water power resources of the United States are based on reports prepared by federal and state governments, by corporations, and by private engineers. In districts for which no water power reports are available, the data used are taken from the estimates of the potential water power of the United States prepared by the Geological Survey in 1908. The estimates of 1908 were prepared without regard to the practicability of developments, but the present estimates are based largely on reports that include only feasible sites. In potential water power, Washington leads the states for power available both 50 per cent of the time and 90 per cent. The total resources of the country are given as 34,818,000 hp. for 90 per cent of the time and 55,030,000 hp. for 50 per cent of the time. This is distributed, on the 90 per cent basis, as follows: New England States, 998,000; Middle Atlantic, 4,317,000; East North Central, 737,000; West

North Central, 871,000; South Atlantic, 2,476,000; East South Central, 1,011,000; West South Central, 434,000; Mountain States, 10,736,000; and Pacific States, 13,238,000. The potential water power of outlying possessions on the same basis is given as Alaska, 1,000,000; Porto Rico, 19,000, and Hawaii, 100,000.

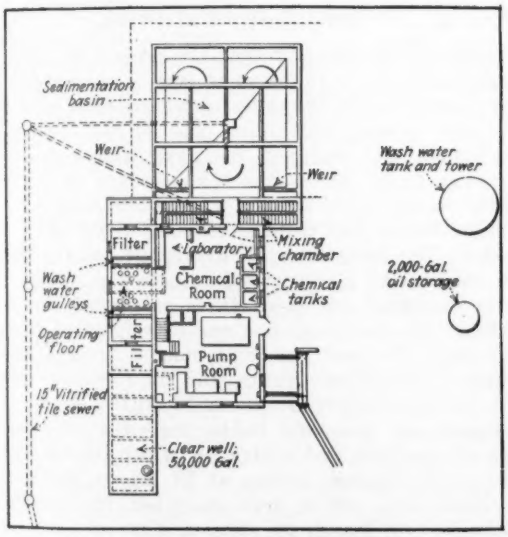
Small Water Purification Plant for Jacksonville, Texas

Filters and Pumps Put Into Small Area Under One Roof—Good Water More Than Doubled Domestic Consumption

BY H. N. ROBERTS, JR.
Civil and Sanitary Engineer, Dallas, Texas

A SMALL compact pump and filter plant under one roof, a low earth dam with heavy clay core wall, filter sand sized on the job, and an unusually large number of bids (62) for a small job were features of the new water-supply recently completed for Jacksonville, Tex., a town of 4,500 people in eastern Texas, at a total cost of $153,000.

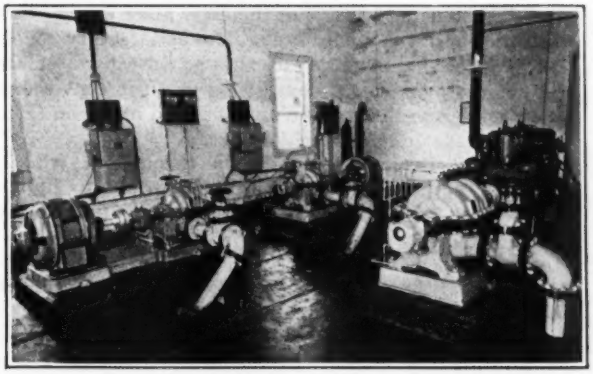
It was decided that dependence could not be placed on



LAYOUT OF 1 M.G.D. FILTER PLANT

a well supply either as to quality or quantity, but that conditions favored a surface supply. The drainage areas of this section consist of beds of fine sand, and sandy loam 5 to 10 ft. in depth underlaid by an impervious clay stratum. This situation gives rise to many springs on the watershed and a remarkably well sustained dry-weather flow in the streams.

The Merrit's Branch site was chosen for an impounding reservoir, as weir observations of flow during the dry months as well as investigation of its past flow history showed a good runoff and there was a good dam-and-reservoir site within 4,000 ft. of two other good reservoir sites, having much larger drainage areas which could later be brought into the development if necessary. The Merrit's Branch storage reservoir has a capacity of 180 m.g.d. with a drainage area of 2.6 sq.mi. The present average water consumption in the city is 250,000 gal. per day.



PUMP ROOM WITH MACHINERY PAINTED WHITE
Oil engine reserve at right with regular motor-driven units at center and left. Chlorinator in far corner.

An earth dam 800 ft. in length and 40 ft. in maximum height, is of a sandy clay, wet and rolled in layers, with a clay core wall 20 ft. thick in the center of the dam. A masonry spillway is designed for 2,500 sec.-ft., and an emergency spillway, closed with a light dike, is designed for 3,000 sec.-ft. flow, giving a combined flood flow capacity of 5,500 sec.-ft. for the 2.6-sq.mi. watershed. The water from the reservoir passes by gravity through a 12-in. cast-iron pipe line to the filtration plant, 900 ft. below the dam.

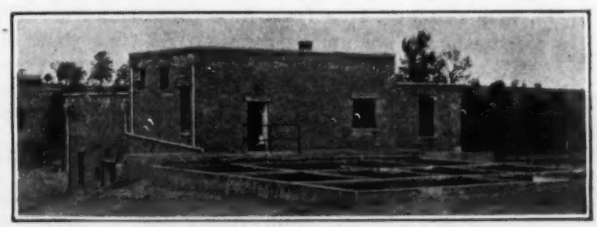
The filtration plant has a capacity of 1 m.g.d It has Harrisburgh type underdrains and high velocity wash without air agitation. The two filters of 185 sq.ft.

COST OF JACKSONVILLE WATER SUPPLY

Dam and control works	$41,000
Filter plant and pump buildings and basins	31,000
Mains and supply lines	28,000
Filter piping and equipment	7,000
Machinery	9,000
Two steel tanks	10,000
Land	14,000
Other expense	13,000
Total	$153,000

area each are manually controlled. Gravel 18 in. deep, varying in size from 3-in. cobbles to ½-in. sizes, laid in five graded layers, covers the underdrain system. On top of this gravel is 32 in. of filter sand of an effective size of 0.40 mm. and a uniformity coefficient of 1.8. As there was no suitable filter sand nearby, it was decided to attempt to use sand and gravel from the Texarkana pits. As it arrived on the job it had an effective size of 0.20 mm. and had to be screened and washed before being placed; after placing it was washed and scraped several times.

When the filter plant was placed in operation the sand had not yet been brought to specified size, but by oper-



JACKSONVILLE FILTER AND PUMP HOUSE
Pump room is in the lower back portion of building and round-the-end baffled sedimentation tanks in foreground.

ating the plant and scraping the beds after every other wash the sand was finally brought to satisfactory condition The second month's run showed a wash-water use of 6 per cent, the third month showed 4 per cent wash-water, and from then on the amount used has been from 2 to 3 per cent of the amount filtered.

The plant is electrically driven throughout with a standby gasoline-engine-driven centrifugal pump. Pumpage cost per 1,000 gal. delivered to the city is 3.5c. for power.

As a result of sending out 70 sets of printed specifications and lithographed maps, 62 bids were received. The work was let for 3 per cent under the engineer's estimate. At the time the bids were taken on this work the *Engineering News-Record* construction cost index was 165, only three points higher than its minimum value since the war. The main items of plant cost are given in the accompanying table. The writer was designing and supervising engineer for the city.

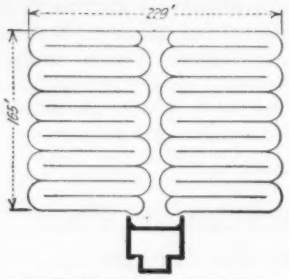
When the plant was first put in operation the lake water was visited by a plague of Daphnia, or "water fleas.' These minute crustaceans became very numerous in the lake and in the settling basins. Preparations were made to chlorinate the raw water, instead of the filtered water, in order to prevent clogging of the filters. However, before the preparations were complete, the Daphnia disappeared as suddenly and as mysteriously as they came. In Texas Daphnia generally come when the water is cool.

New Spring Water Supply and Covered Reservoir, Batavia, D. E. I.

By C. Ortt
Civil Engineer, Bondoeng, D. E. I.

SPRINGS located on the lower slopes of Mount Salak, 900 ft. above sea level and 32.5 miles from Batavia, a seaport city of Java, Dutch East Indies, a pipe line of Mannesmann steel tubes of 18- to 24-in. internal diameter and a length of 26 miles, a 5.5 U. S. gal. flow-equalizing covered reservoir, 7.5 miles from and 150 ft. above the city, two 24-in. cast-iron supply mains therefrom, and about 16 miles of distributing mains constitute water-works improvements recently made by the city of Batavia at a cost of about $3,600,000. For the supply mains nine bridges of from 190- to 20-ft. span and five siphons were built. Except the reservoir, which was contracted for, all the work was done by the Water Department of Batavia.

Until this new supply was completed the city depended on artesian wells. These were increased in number from one in 1843 to 90 in 1921. At the outset the quantity and pressure of the well water was sufficient but the water was yellow colored, had a high temperature (39 deg. C. or 102 deg. F.), contained humic acid, and although free from lime contained from 270 to 570 p.p.m. of sodium carbonate. As time went on population increased and the yield and pressure from the wells diminished. Pumping hastened the relative exhaustion of the well supply. Plans for the new supply were made as early as 1904 but construction was not begun until 1918.



BAFFLES FOR BATAVIA RESERVOIR

Thus far only 92 of the 132-g.p.s. (not stated whether U. S. or Imp.) estimated yield of the springs has been developed. It is expected that the smaller amount (about 8 m.g.d.) will be sufficient until 1930. The extended site of the springs is fenced with barbed wire. The water is collected in covered drains.

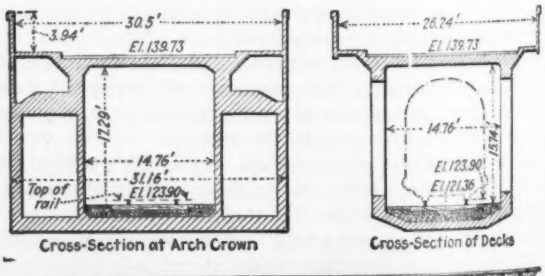
The equalizing reservoir is of reinforced-concrete, supported by piles of the same material. The baffle walls (see sketch plan) give anchorage for the multi-circular side walls and carry the roof.

France Plans to Build 672-ft. Span Reinforced-Concrete Bridge

Plans Accepted on Three Long Span Structure to Carry Rail and Road Traffic Over Tidal Estuary at Brest

IN SPITE of the fact that the project is being held up for three years owing to lack of appropriation of government funds, the plans for a three-span reinforced-concrete bridge, containing the longest arches yet attempted, and designed to carry both railroad and highway traffic across the tidal estuary of the River Elorn in Brittany, France, have been accepted. The bridge, when constructed, will link Brest with Plougastel. The designer is M. Freyssinet and the successful bidders the Enterprise Limousin Co. Eight other firms competed, of which three submitted bids for a metallic structure and five one of reinforced concrete. For metal bridges, the bids ranged from 11,360,000 francs to 13,796,000 francs, and for concrete construction from 7,340,000 francs to 16,170,000 francs. The designer and successful bidder form the same association of engineer and contractor which constructed the long arch concrete bridge at St. Pierre du Vauvray in Normandy, which was described in *Engineering News-Record*, March 20, 1924, p. 476.

The estuary, which has an extreme width of 2,300 ft., will be crossed by approach viaducts from either end



SECTION AND ELEVATION OF LONG SPAN CONCRETE BRIDGE

425 ft. long and three spans of 613.36 ft., 639.6 ft., and 672.4 ft., all c. to c. of the piers. The clear spans are not given in the information now available.

Plans provide for a free navigable channel 230 ft. wide and with a height from water surface to the arch crown of the principal span of 118 ft. The arches are identical in construction, of a radius of 459.2 ft. They will be built up of parallel, hollow ribs of a rectangular section; the width of the rib is 8.7 ft.

The prevailing width of the upper or highway deck is 26.24 ft. out to out of sidewalks. The width of the roadway itself is 19.68 ft. with the rest of the width in cantilevered sidewalks. However, this overall width is increased at the crown of the arch to 30.5 ft. The railway level will be at a distance 17.29 ft. below the underside of the highway deck. This latter will have a prevailing thickness of around 1 ft.

The bridge will carry the regular freight and passenger business of the Chemin de Fer de l'Ouest-Etat. The roadway or upper platform will be classed by the Bureau des Ponts et Chaussées as a Chemin de Grande Communication (the third classification in order of importance among French government roads). Communication between points which the bridge will link is now by ferry; the construction of the bridge will therefore save a detour of about 12½ miles.

The two river piers will be set upon pile foundations sunk to granite bed rock.

Under strict specifications the departmental or county commission demanded guarantees of security and completion date which only the Freyssinet-Limousin combination completely met. The construction company's responsibility extends over a period of ten years.

Microscopic Structure of Softwood

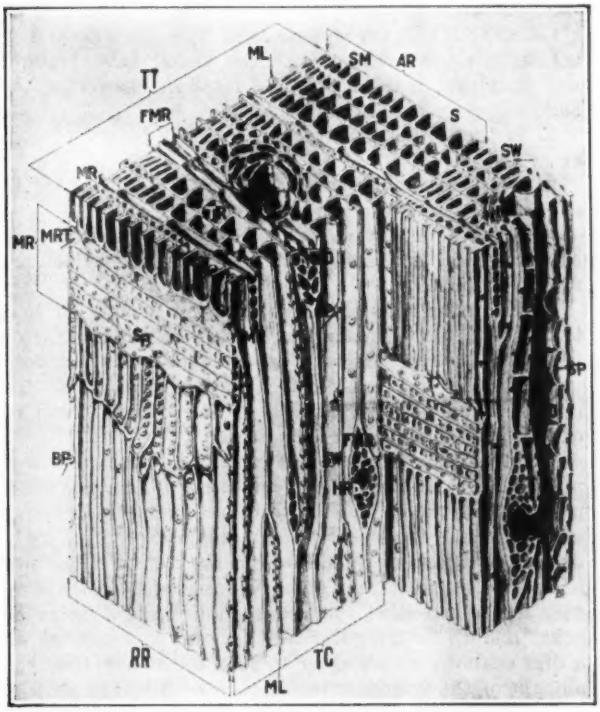
SINCE the microscope cannot bring several planes into sharp focus at the same time a drawing of the cell structure of a minute block of softwood has been made by a wood technologist of the Forest Products Laboratory, Madison, Wis. The block of white pine shown is a cube less than ¼ in. on a side and the technologist explains the functions and structure thus:

Wood, instead of being a relatively solid material like steel or concrete, is seen to be composed of many tubular fiber units or cells cemented together and having on their walls thin areas for passage of sap.

The top of the block represents a plane parallel to the top surface of a stump or the end surface of a log. The rectangular units which make up this surface are sections through vertical cells, mostly tracheids or water carriers *TR*, the walls of which form the bulk of the wood substance. Between the various cell units is a cementing substance called the middle lamella, *ML*. Springwood cells *S*, distinguishable by their greater size, and summerwood cells *SM* are formed during the early part and the latter part of a year's growing period, respectively. The growth of the springwood is the more rapid. Together the springwood and the summerwood cells make up the annual ring, *AR*, added to the outside of the tree.

The function of the medullary rays *MR* is to store and to distribute horizontally the food material of the tree. These rays—including the fusiform medullary rays *FMR*, or rays having horizontal resin ducts *HRD* at their centers—are found on the end of a stick as fine white lines radiating from the center. The large hole in the center of the top surface is a vertical resin duct.

The left side surface *RR* represents a vertical plane along the radius of the trunk. This surface—commonly called "edge grain" in softwoods and "quarter-sawed" in hardwoods—is not so distinctively marked in the softwoods as in the hardwoods. In some hardwoods, the "quartered" surface with its large lustrous



STRUCTURE OF SOFTWOOD

"flakes" formed by medullary rays entering and leaving the plane of the saw is valued for use in furniture because of its attractive figure.

The symbol *SP* indicates a simple pit, an unthickened portion of the cell wall through which sap passes from ray cells to fibers or vice versa. The bordered pits *BP*, seen in section on the surface *TG*, have their margins overhung by the surrounding cell walls. The surface *TG*, at right angles to the radial or quarter-sawed surface, corresponds to the flat grain or plain-sawed surface of lumber.

Rights in Pipes Under an English Railway

That the London & Northeastern Ry. may not build a fill to replace a viaduct over an abandoned private road because a main of the Metropolitan Water Board is laid 5 ft. under this road, is the recent decision of an English court. Under the easement granted to the Board the railway company reserved the right to alter and widen its works without being liable to compensate the Board for damage except by "wilful act." When the new 14-ft. fill was proposed the Board claimed that the pipes would be subject to damage by vibration of passing trains and that the railway had no right to damage or obstruct access to the pipes. The court sustained this view and held that if the company executed the proposed work any damage done thereby would be the result of a "wilful act."

Smoothness Surveys Urge Reforms in Road Design

Traffic Not Primary Cause of Pavement Failure
Greater Slab Thickness Unwarranted
Better Foundations Urged

By Harley Dunbar

Assistant Engineer, Division of Highways, Albany, N. Y.

SMOOTHNESS surveys made in New York State during the past season with the vialog have brought out data that make a start at least in answering the following important questions:

1. Is traffic the primary cause of the failure of concrete pavement?

2. What is the economic limit of the thickness of a reinforced-concrete pavement slab?

3. Are we not in danger of passing this limit, in some localities at least, in the present tendency toward mass concrete?

If the answer to the first question should be that traffic is not a primary but only a secondary factor in the failure of concrete pavements—and from data presented in this article such would seem to be the case—then a positive change in the present trend of design and construction is indicated.

A description of the vialog and its operation was published in *Engineering News-Record*, Jan. 10, 1924, p. 74. The vialog is a compact recording instrument attached near the dash of an automobile. By simply driving a car so equipped over a road at 25 miles per hour an automatic and autographic record of the surface irregularities of the pavement is made on a paper chart and these irregularities are also summed up on a dial enabling an observer to read off at any time the amount of the irregularities encountered by the vehicle. By this means the various types of pavement are given a smoothness rating in inches of surface irregularities per mile. These ratings are expressed as follows:

35 in. or below	Excellent
35 in. to 125	Very good
125 in. to 200	Good riding pavement
200 in. to 250	Fair riding pavement
250 in. and above	Rough

New York state highway specifications require that new pavements should rate as follows when accepted:

Vitrified brick	50 in. per mile or less
Asphalt block	50 in. per mile or less
Concrete	50 in. per mile or less
Bit. macadam, mixing method	75 in. per mile or less
Bit. macadam, penetration method	125 in. per mile or less

Let us first consider an analysis of the ratings showing the surface conditions of some 300 miles of concrete pavements built during the years 1918 to 1923. Bear in mind that these ratings give the condition of the pavements in 1923 and not in the years built:

Year Built	Miles	Inches per Mile
1923	61.20	53
1922	111.10	75
1921	102.04	100
1920	27.67	96
1919	28.69	110
1918	17.76	114

The pavements on which these inspections were made are scattered all over New York state. The soil conditions vary from sand on Long Island to sandy loam and clay elsewhere. A similar tabulation of pavements on Long Island only is as follows:

Year Built	Miles	Inches per Mile
1923	2.6	48
1922	13.09	60
1921	21.00	60

Taking the state as a whole, note the big jump in irregularities of the pavements built in 1921 and 1922, only one and two years old, as compared with the brand new 1923 pavements which had not then passed a winter and spring with the resultant settlement and frost action. Assuming the average workmanship in the pavements built during these years to be the same, the irregularities appear to have practically doubled in the first two years of the pavements' existence. But this is not the case on Long Island where soil conditions are favorable and where the winters are not so severe, there being an increase here of only 12 points the first year and the next year none. (See chart.)

Now let us consider the individual case of Highway 8,084, Albany County, a reinforced-concrete pavement 5.9 miles in length on what is known as the Empire State Route running west from Albany. This pavement was built in two sections each 8 ft. wide and 7 in. thick, with the thickness increased to 9 in., with double reinforcement of steel in short stretches over particularly unstable conditions of subsoil. A small amount of 6-in. field stone foundation course was placed in some of these bad spots. The soil varies from sandy loam at the eastern end to heavy clay at the western, with the dividing point between the two about 1.5 miles from the eastern end. About 3.6 miles of this road was graded and paved during 1922 and the remainder or 2.3 miles was graded and paved in 1923.

In November of 1923 a vialog inspection was made of this pavement. The portion built in 1922 had passed through a long severe winter with deep frost and heavy snowfall but had had very little traffic. The 1923 portion was just completed when the inspection was made. The result of inspection in surface irregularities mile for mile follows:

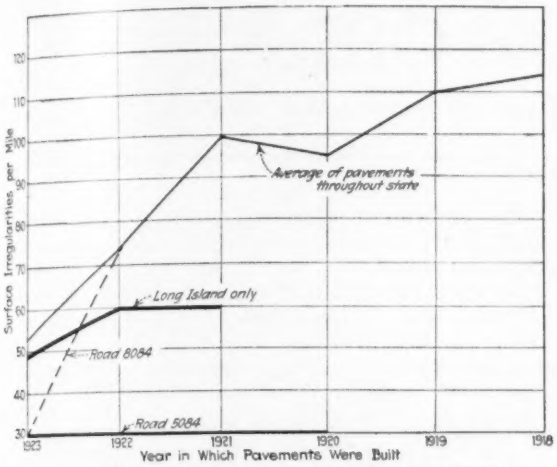
Distance, Miles	Year Built	Inches per Mile
1.0	1922	75
1.0	1922	75
1.0	1922	72
0.3	1922	70
0.6	1923	30
1.0	1923	23
1.0*	1923	41

* 1,000 ft. of 8 per cent grade in this mile.

Note that the irregularities in the portion built in 1922 are now more than double those in the portion built in 1923. Identically the same organization, including engineer, contractor and finishers on the concrete, built both portions and it is reasonable to assume that the workmanship of 1922 compared favorably with that of 1923. It is certain that at least one mile of the 1922 work would have rated as good or better than 40 if an inspection had been made that year. In general all of the 1922 slabs were in good condition when the inspection was made except for uneven joints caused by the movement of the slabs. These movements, according to the engineer in charge, G. V. R. Arthur, took place during the spring and early summer and many of the joints never returned to their original position. One slab had to be entirely removed and replaced on account of an earth fill sliding out from under.

From the vialog inspection, the irregularities were practically doubled in one year as a result of the movement of the slabs of an unstable subsoil. This may be compared to the average of the concrete pavements taken throughout the state in which the irregularities were doubled in two years. (See chart.)

Real Cause of Irregularities—Now it is evident that the cause of these slab movements is unstable subsoil,



SMOOTHNESS RATINGS OF NEW YORK CONCRETE ROADS INSPECTED IN 1923

which in turn is the result of the working of natural forces such as settlement, frost action, and moisture and the remedy is not in so-called scientific design of the concrete slab with its attendant careful placing of reinforcement of just the proper weight and the increase of slab thickness at particular points to compensate for carefully computed stresses. Although these are important aids they would seem to treat the effect rather than the causes.

The true remedy is in correcting the conditions outside the slab that cause these stresses.

Would it not be preferable in a project 5 or 6 miles in length that ordinarily will require two years to build anyway, to spend the first year in grading and in building drainage structures including blind and tile drains, and if the soil conditions require it building foundation courses of field stone or gravel or both? This will give opportunity for the earth fills to settle and in the following spring the engineer in charge may apply the proper remedy to correct any adverse conditions in the subgrade that may have developed during the winter. Then the concrete pavement may be laid on a consolidated substructure the entire length of the road.

If the above briefly outlined procedure is followed would it not be sound engineering to treat a concrete pavement simply as a top course the same as any other type instead of requiring it to take the burden of fulfilling the requirements of a foundation and a top course all in one, at the same time expecting it to stand up under the abuse of poor drainage and the punishment of traffic?

The forces of nature will move a 10-in. slab of concrete just as easily as they will move a 5-in. slab. It is true that a 10-in. slab doubly reinforced will withstand greater stresses than a 5-in. slab, but why subject them to these stresses when by proper methods of construction and treatment of subsoil conditions it is possible to do away with the greater portion of them and reduce cost? The destructive influence of impact from traffic cannot then be set up and the result is a smooth riding pavement with a longer life and with a minimum expenditure for maintenance.

In support of this contention, Highway 5,084 in Rensselaer County is cited as an example. This concrete pavement is a reconstruction job replacing one of the worst sections of waterbound macadam on the Albany-New York post road. This macadam turned upside down every spring due to poor drainage. This condition was corrected by the use of considerable tile drain laid under the existing ditches. A spring of water in the center of the macadam was drained off by the same means. A foundation course of field stone was placed where condition of macadam indicated a poor bearing subsoil. This pavement was built 7 in. thick in the center and 5 in. thick at the outer edges with light reinforcement placed midway between upper and lower surfaces, thus violating all theories of modern design. It has now been subjected to four seasons of severe weather conditions and the heavy traffic plying between New York and Albany; it shows no sign of failure in any way and has a vialog rating of 30 (see chart) simply because it was built smooth in the first place and has remained that way for the reason that it is perfectly supported by a stable foundation.

From a comparison of this road with Highway 8,084 it would seem that a 5-in. or 6-in. concrete pavement well supported will withstand the ravages of time far better than a 9-in. pavement harassed above by traffic and below by the insidious giving way of an uncertain foundation which steel and concrete cannot control.

We surely are not consistent when we go to the trouble and expense of building many miles of concrete pavement using painstaking care to see that they are extremely smooth when first finished, in a futile attempt to escape the destructive effect of impact from traffic, only to see them rough and uneven from natural forces and at the mercy of traffic inside of two years.

Again referring to the chart all the lines shown there represent actual results obtained either as an average throughout the state or in particular cases as under favorable conditions on Long Island or under adverse conditions as in the case of Roads 8,084 and 5,084. The result we should try to approach is illustrated by a line representing Road 5,084.

Vialog Tests to Be Made—As we are now in possession of data taken last year showing the surface irregularities in various pavements built during the season, vialog inspections to be made during 1924 will tell us just what the effect of one rather mild winter has had on them and the comparison of these records will perhaps shed more light on the subject herein discussed.

At this time, when there seems to be some confusion in regard to concrete pavement design, would it be amiss to suggest that highway engineers tear a leaf from the railroad engineers' book comparing the semi-rigid concrete and steel pavement to the semi-rigid steel rail supported on ties which in turn rest on a crushed stone or gravel ballast comparable to our bottom course, all of which repose on an earth embankment flanked on either side with adequate ditches.

To sum up briefly, the conclusions derived in this article in answer to the questions asked herein are:

Traffic not being the primary cause of the failure of our concrete pavements, it follows that increasing the thickness of the slab and the amount and weight of the steel beyond a certain economic limit is *not* the proper means to employ for prolonging the life of the pavement and *this limit is certainly not over six inches of thickness* in a region of self draining subsoil or one that can be drained by tile drains or in localities of abundant field stone or gravel available for supporting courses to strengthen weak subsoil.

From Job and Office

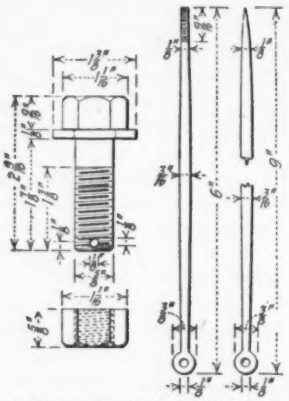
Hints That Cut Cost and Time For the Contractor and the Engineer

Patch on 20-In. Steel Pipe Bolted Entirely from the Outside

By W. W. Monk

Foreman Pipelayer, Shanghai Waterworks Co., Shanghai, China

SOON AFTER a 20-in. steel water main had been laid on a concrete bridge, and after the main had been under test for a few days, one of the right-angled steel bends suddenly cracked in the center. This bend was situated in a very tight corner and was cemented in at the corner of the bridge's abutment. The engineer-in-chief gave orders that this bend was to have a steel patch placed over it and was to be bolted on with ⅝-in. bolts and nuts. The most difficult part of this job was to get the bolts in place without any person entering the pipe to place or hold the bolts there by hand; no holes were cut in the steel pipe except the bolt holes. The work was done as follows:



BOLT AND HOLDING BAR FOR PATCHING 20-IN. PIPE

(1) I filed to a smooth surface the outside of the steel bend over the cracked part, which was 14 in. in length and ⅞ in. wide. (2) I made a 5½ x 14-in. patch of a ⅜-in. boiler plate (this I also filed down to suit the angle of the steel bend). (3) A clip was made to pass over the patch and around the steel pipe so as to hold this plate in position whilst drilling operations were started, the clip being so arranged as to be screwed up tight. (4) A ⅝-in. hole was drilled through the patch and the steel bend after which operations began on getting the 18 bolts into place. (5) To one end of a cat-gut line about 300 ft. in length I attached a piece of wood ½ in. in diameter and 3 in. long, passing this and the gut-line through the hole that had already been drilled. The ⅝-in. hole was then closed with a small wooden plug. The water was then turned on, the main filled and the washout opened. The rush of the water brought with it the small piece of wood and the line. The pipe was then allowed to drain. (6) I then drilled the remaining 17 holes, fastened one bolt after another and pulled them into their places with the line. (7) A ⅛-in. hole was drilled and tapped at the end of the bolt, a small set pin was made to screw in, which enabled the holding of the bolt at any desired angle if necessary; this also held the bolt in its place while the washers and nuts were being put on and screwed down fairly tight. There was also a ⅛-in. hole drilled through the neck of the bolt and a small bar was passed through it; by holding this bar with one hand and screwing up with the other the bolt was kept from turning. Washers and grummets were used both inside and outside, and a very neat and reliable job was executed.

The time taken to put the bolts into their places was three hours owing to the difficult corner in which we had to work. Welding a patch on would have been unreliable and perhaps impossible owing to such small space being available. The cost would have been considerably more if welding had been done.

Pipe Culverts Placed by Jacking

By A. Griffin

Canadian Pacific R.R. Co., Brooks, Alberta

INSTALLING culverts by jacking them into position, described in *Engineering News-Record*, Dec. 13, 1923, p. 989, has not been as widely used as its merits warrant. While the writer was chief engineer of the South San Joaquin District in California he used the method repeatedly in a variety of conditions, and it became a standard practice with his successors and is still standard practice, it is believed.

The first use of the method was in jacking an 18-in. cast-iron pipe under the Southern Pacific R.R. This was in dry material and while the method was distinctly superior to and cheaper than an open excavation, a considerable body of material was forced ahead by the bells. This required extra power and also loosened up the roadbed, although in this respect it was more satisfactory to the railroad company than an open excavation. As the pipe was shoved ahead the material was excavated by a small man lying flat in the pipe, and was removed in a pan which was dragged out and back into the pipe by means of two ropes.

FIG. 1—JACKING TWO CULVERTS RIGHT AND LEFT SIMULTANEOUSLY

FIG. 2—ARRANGEMENT FOR JACKING CULVERT PIPE THROUGH EMBANKMENT
Left: Support for hydraulic jacks. Right: Thrust bearing against pipe.

One of the largest and most difficult jobs was the jacking of a 48-in. diameter corrugated pipe, 64 ft. long in 20-ft. sections under a state highway. Two 30-ton hydraulic jacks were used. At least half the diameter of the pipe was in saturated quicksand, which made it difficult to secure a substantial support from which to operate the jacks. When the pipe was nearly through it shortened and lengthened by compression and expansion of the corrugations, about 6 in. or about half the travel of the jack, which made the process slow and tedious. This pipe, however, was large enough for a man to work inside with a wheelbarrow. Fig. 2 illustrates the arrangement for jacking. The pipe kept closely to line laterally, but dipped about 6 in.

A later operation, April, 1917, was the simultaneous jacking of two 36-in. corrugated pipes; one of them under a state highway and the other under an electric railroad. Fig. 1 indicates the process. In this work a more convenient type of hydraulic jack was used; the pump and ram were separate and were connected by flexible copper tubing. The jack worked conveniently in any position. The capacity was 60 tons and the extension was 18 in.

The jacking of a 30-in. concrete pipe under a state highway is shown in Fig. 3. The pipe was 6 in. in thickness. The soil was saturated sand and quicksand and in some instances the line of saturation was up to the top. The water was pumped down low enough for a man to excavate inside.

In installations of this kind it was common to jack the pipe for a distance of 20 to 30 ft. in order wholly to avoid any interruption to traffic. There was some difficulty at first in holding the pipe to exact grade, but this trouble was largely due to getting sand between the ends of two sections below the water level. There was no trouble from this source as soon as it was learned that sufficient precautions must be taken to insure uniformly close contact entirely around the pipe This type of installation is particularly simple and easy as it is not necessary to increase the length of the timbers leading from the jack to the pipe as it is shoved ahead.

In another case the culvert was reinforced concrete 42 in. inside diameter and with walls 6 in. in thickness. The height therefore was 54 in. and the base was flat and 54 in. wide. The culvert was constructed on a wooden platform accurately to line and grade and as near the track as possible. After it had thoroughly set it was launched through the railroad embankment by means of a 60-ton hydraulic jack. Nearly half the pipe was below the line of saturation although the material was of clay and stood up well. The work of launching took four men two days.

There was absolutely no interruption to railroad traffic and trains were not even put on slow orders. The pressure was normally kept between 50 and 60 tons and the men inside the pipe excavated far enough ahead and near enough to the outside of the pipe to allow it to

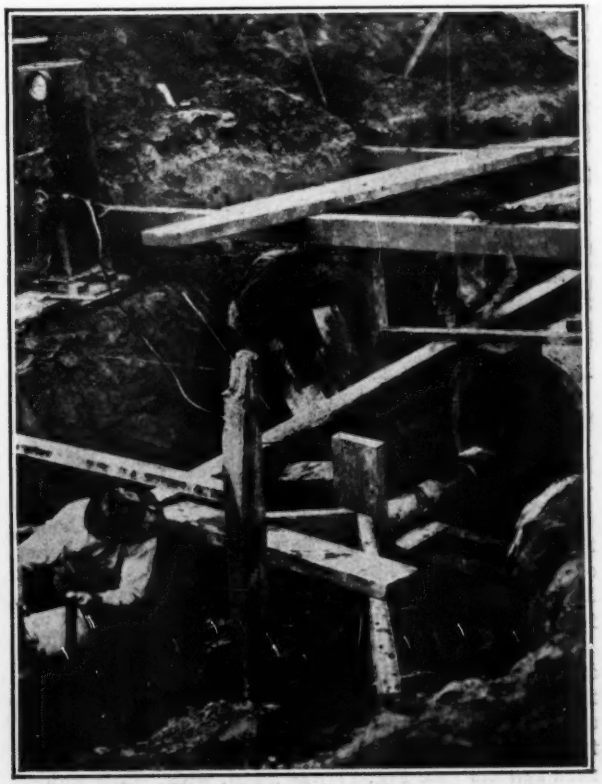


FIG. 3—JACKING BELL AND SPIGOT CONCRETE PIPE

move forward within this range of pressure. When a train was passing over the work the pipe moved forward a little more readily at a lower pressure, due no doubt to the vibration. The only supervision considered necessary by the railroad company was to instruct the section foreman to keep an eye on the work, which he did by having his crew work in the vicinity.

A number of advantages of this method of construction suggest themselves. We considered the method cheaper than any other practicable means of making the installations. From the standpoint of the railroad company and the public it was a distinct advantage in that it did not interfere with traffic and did not disturb the foundations of the highway or the railroad. When open excavation is used there is always a shrinkage of the backfill over quite a long period, but under the method described it is not necessary that there should be any disturbance even to a concrete road surface.

Further Studies of Discharge Through Adjustable Submerged Orifices

By H. A. Wadsworth
Assistant Professor in Irrigation Practice, College of Agriculture, University of California, Davis, Calif.

RESULTS OF observations on the discharge through adjustable submerged orifices were reported in *Engineering News-Record*, Feb. 15, 1923, p. 308. It was demonstrated that the old formula, (1) $Q = A \times C \times \sqrt{2\,gh}$, was unsuited for use with crude timber structures. As a means of securing greater accuracy

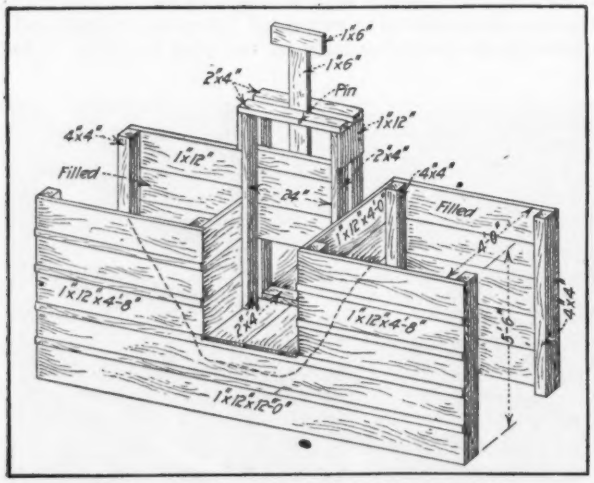


FIG. 1—DETAILS OF GATE AND ORIFICE USED IN STUDIES

in the field a new formula was suggested, (2) $Q = A \times C \times \sqrt{2\,g} \times h.^{0.484}$ In this formula C ranges from 0.62 for large areas to 0.855 for small areas. Although this new formula was well suited to the limited number of observations upon which it was based, the observations were not numerous enough to establish the reason for the change from the commonly used equation.

During the summer of 1923 additional work on the discharge through timber orifices was carried on at the hydraulic laboratory at Fort Collins, Colo. The observations were made on a gate differing somewhat from that described in the earlier article. The gate used in 1923 (see Fig. 1) was 24 in. wide. Gate guides

From Job and Office

Hints that Cut Cost and Time

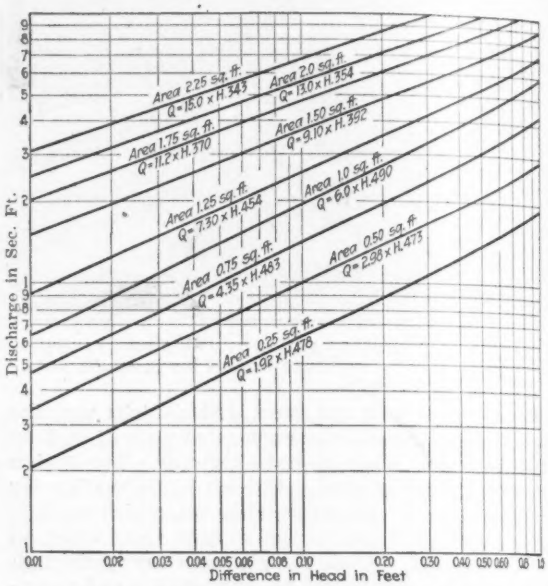


FIG. 2—DISCHARGE THROUGH ADJUSTABLE SUBMERGED ORIFICES

Based on observations at Fort Collins, Colo., June, 1923, on orifice 24 in. wide, with 2x4-in. gate posts.

were of 2x4-in. stock pine; a 2x4 laid flat on the floor of the flume furnished a sill for the gate when closed.

With this type of gate, 107 observations were made with openings ranging in size from 0.25 to 2.25 sq.ft. The observed differences in head ranged from the smallest difference which could be read by the hook gages to the greatest capacity of the gate.

It was noted that when the observations of discharge and difference in head on a certain area were plotted on logarithmic co-ordinate paper a straight line resulted. The corresponding observations for other areas plotted as other straight lines. These lines, together with the equations resulting from observations on the

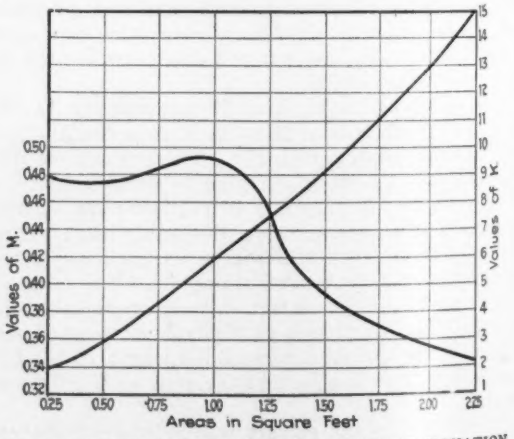


FIG. 3—CONSTANTS FOR USE IN GENERAL EQUATION $Q = K \times H$

For determining discharge through adjustable orifices

From Job and Office

For Contractor and Engineer

areas mentioned above, appear in Fig. 2. The fact that these lines do not have a constant slope makes it evident that no single exponent of the difference in head would be equally correct for all areas.

With such a graph as this prepared for the special type of gate under consideration the computations required by an observation on such a gate would be minimized. If such a graph is not available the computations leading to the discharge are not difficult. Since each of the lines shown on the logarithmic paper is a straight line the general equation for a parabola, (3) $Q = K \times H^M$, will satisfy them all. It is evident that the constant K in this equation becomes greater and that the exponent of H becomes less, as the areas become greater.

Fig. 3 has been prepared as an aid in determining the discharge through areas of intermediate size. From it the values of K and M can be obtained for use in the general formula and the discharge readily determined.

It must be remembered that these diagrams are applicable only to structures built in accordance with the design shown in Fig. 1. The equation for discharge through an orifice of 2 sq.ft. of the type shown in Fig. 1 might be quite inaccurate if applied to an area of 2 sq.ft. if that orifice were 3 ft. wide and 8 in. high.

Sound Rod for Cross-Sectioning Canals

By W. F. Heath
Engineer, Cameron County Water Improvement District No. 2, Cameron, Tex.

A SOUNDING rod used in cross-sectioning canals when full of water is shown by the accompanying sketch.

About a year ago we bought a dredge to clean out our canals and were desirous of finding the yardage taken out each month. During the summer months we got the cross-section by letting the rodman wade in the canal and get the depth at various distances out. When winter came it was too cold to let a man wade and most of the canals were more than boot deep. Accordingly a rod made out of ¼x1¼-in. strap iron was devised. We made this rod in 3-, 4-, and 5-ft. lengths with a 3-in. shoe to keep it from sinking in the silt on the canal bottom. The face of the rod was painted and divided into tenths of a foot for its entire length; the foot marks were painted on in red and the tenths in black. A ⅜-in. diameter hole was bored at the top of the rod with its center ½ in. from the top and 100 ft. of sash cord was passed through this hole so that the rod was at the middle of the sash cord. We then wired the rod to the sash cord to keep it from slipping and turned up one end of the wire in such a manner that the end of a metallic tape could be hooked to it.

SOUNDING ROD

When using this rod, one rodman stands on each bank of the canal; one on the side where the reference stake is located. This man holds his end of the cord and the metallic tape. The man on the other bank pulls on his end of the cord and the rod is let down at intervals. The man on the stake side gives the distances out from the stake and the depth of water. The water level is determined at every three or four stations and the part of the canal above water is measured in the regular manner. By using this rod we can do the work quicker than by putting one of the rodmen in the water.

Tests on Holding Power of Lead Joints in Water-Pipe Plugs

By John H. Quense
Junior Water Supply Engineer, Seattle, Wash.

IN THE design of shackles for water-pipe plugs, tests were conducted to determine how much holding power the lead alone offered to prevent the plug from moving. The tests were made on a 300,000-lb. Riehle testing machine in preference to rigging up a water-pressure test. One test each was made of 6-, 8-, 12-, 16- and 20-in. joints. In the case of the 6- and 8-in. joints the plugs were leaded into a hub-and-flange casting, and for the 12-, 16- and 20-in. joints the plugs were leaded into a sleeve. The dimensions were as shown in Table I and in Fig. 1. They were substantially as required by the American Water Works Association. The plugs were placed directly under the head of the machine in the case of the 6-, 8- and 12-in. plugs, but in the case of the 16- and 20-in. plugs, they had to be offset with a beam, as shown in Fig. 3, the outside diameter of the sleeves being too large to permit placing directly under the head of the machine.

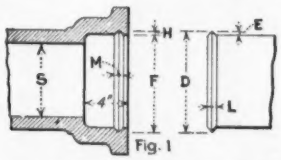


Fig. 1

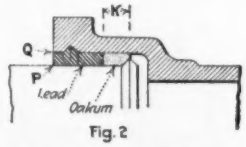


Fig. 2

FIGS. 1 AND 2—SECTIONS OF PIPE AND PLUG

In all tests the plugs were partly filled with sand to get an even bearing, using a wooden strut to shove the plug out. It was assumed that when the plug started to move the point of failure had been reached. In every case, the slipping took place on surface *P* (Fig. 2), between the lead and the plug, except in the case of the 16-in. size. In this case, a slight movement took place on surface *Q* between the lead and the inside of the bell before the plug slipped on surface *P*.

In the case of the 6-in. plug, the plug started to move at 9,850 lb. The load remained constant while the plug

TABLE I—DIMENSIONS OF PLUGS IN INCHES

Nominal Size (Diam. S.)	20	16	12	8	6
D (spigot diam. of plug)	21	18	13¼	9¼	7
E	1	1	1+	1	1
L	1	1	1	1	1
M	1⅛	1⅛	1	1	1
F (ins. diam. of socket)	23	18	14	10	8
H	1	1	1	1	1
Depth of lead	2	2	2	2	2
Annular lead space	11/16	11/16	11/16	11/16	11/16

TABLE II—TESTS OF HOLDING POWER OF LEAD JOINTS

Size of Plug, In.	Load at Which Plug Started, Lb.	Area of Plug, (Diam. D), Sq.In.	Pressure on Plug, Lb. per Sq.In.	Circum. Area P, Between Lead and Plug, Sq.In.	Pressure on Circum. Area P, Lb. per Sq.In.	Depth of Lead, In.
6	9,850	45.7	215.5	53.9	182.7	2½
8	13,500	76.6	176.2	69.8	193.4	2½
12	17,100	148.5	115.3	97.2	175.9	2½
16	29,750	254.5	116.8	115.5	191.3	2½
20	42,000	375.8	111.7	186.2	225.5	2½
24*	46,250	564.1	81.9	236	195.9	2½
30*	56,875	865.7	85.1	291.2	195.3	2½

* Loads interpolated.
The speed of the testing machine head was 0.14 in. per minute.

traversed a distance K approximately equal to the depth of the oakum. At that point, the load rapidly increased to 28,190 lb., when the casting burst, due to wedge action of the bead on the plug with the lead. Table II

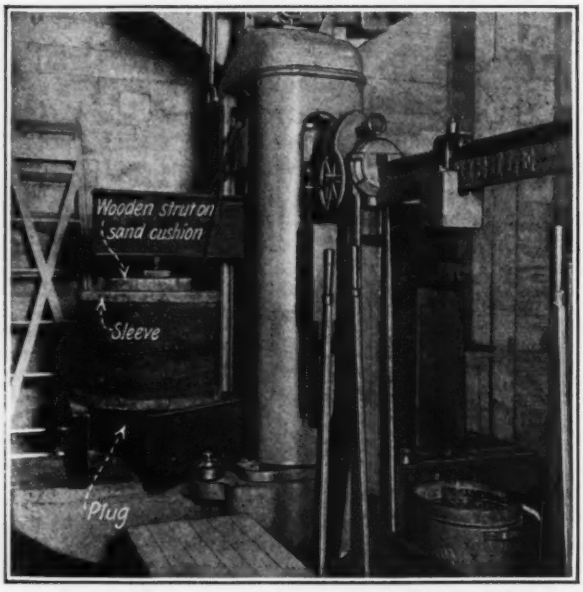


FIG. 3—TEST OF 20-IN. LEAD JOINT IN PIPE PLUG

gives the test data. These joints were made in every respect to correspond as nearly as possible to the joints made in actual practice. The castings had been painted previously with ordinary asphalt paint.

T. H. Carver is water-supply engineer of Seattle.

Quick Valve Repairing

By M. L. Worrell

Engineer and Manager, Water-Works, Vicksburg, Miss.

IN REPAIRING valves, commonly called "gates," it saves time and money to assemble every part of a new valve, except the main casing when that is not needed, and after first preparing the old valve for easy dismantling, place the new bonnet, with assembly of parts, upon the fixed main casing, screw the nuts on the bolts, turn on the water and go your way rejoicing, with the good will, wish and affection of the observant consumer. Never undertake to salvage a penny's worth on the job; that can be done later. Mention is made of only those parts liable to give trouble. A main casing is entirely another matter, but even at that the repair can more quickly be made, when the casing is damaged beyond repair, by inserting a new valve, complete, salvaging the parts later.

From Job and Office

Hints that Cut Cost and Time

Hydraulic Laboratory and Field Tests of Indicating Totalizing Meter

By Prof. W. S. Pardoe

Professor of Civil Engineering, University of Pennsylvania, Philadelphia

TESTS conducted in the hydraulic laboratory of the civil engineering department of the University of Pennsylvania on a Simplex water meter when measuring the flow through a 12 x 6-in. Venturi tube (see curves in *Engineering News-Record*, Sept. 23, 1920, p. 589, by the writer) were made for the purpose of answering the question of the engineer or customer: "is the field test of a meter of this type an accurate measure of its performance in service?" The following data indicate that the answer is yes if the meter is constructed correctly and the coefficient of the Venturi tube is correct for all rates from minimum to maximum.

The field test shown graphically by Fig. 1 gives an average accuracy of 100.015 per cent with a minimum of 99.44 per cent and a maximum of 101.98 per cent for about 5 per cent of the rated capacity of the meter. The hydraulic laboratory test shown graphically by Fig. 2 gives an average accuracy of 100.088 per cent with a minimum of 99.30 per cent and a maximum of 100.95 per cent for about 4 per cent of the rated capacity of the meter.

The field test was conducted as follows. A stock Simplex meter was set up in the laboratory as shown by Fig. 3, using a special large dial for this test. The meter was subjected to a water column pressure of 0.0358 ft., corresponding to a velocity of 0.3705 ft. per second in the main, and the long and short dial pointers set. The water column then was increased to 2.5 ft., corresponding to a velocity of 1.545 ft. per second, and the reading of the pointer checked. The pressure was then equalized and the zero stop set. The traction wheel driving the totalizing mechanism is brought to the center of the disc which is rotated by a clock at a speed of two revolutions per hour. The meter is now in adjustment and is subjected to heads varying from 7.99 to 0.024 ft. (corresponding to the heads used in the lab-

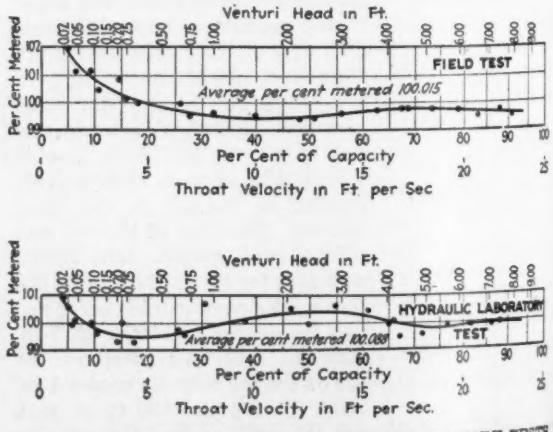

Venturi Head in Ft.
Per Cent Metered
FIELD TEST
Average per cent metered 100.015
Per Cent of Capacity
Throat Velocity in Ft per Sec
Venturi Head in Ft.
Per Cent Metered
HYDRAULIC LABORATORY TEST
Average per cent metered 100.088
Per Cent of Capacity
Throat Velocity in Ft per Sec.

FIG. 1—COMPARISON OF FIELD AND LABORATORY TESTS OF SIMPLEX WATER METER

From Job and Office

For Contractor and Engineer

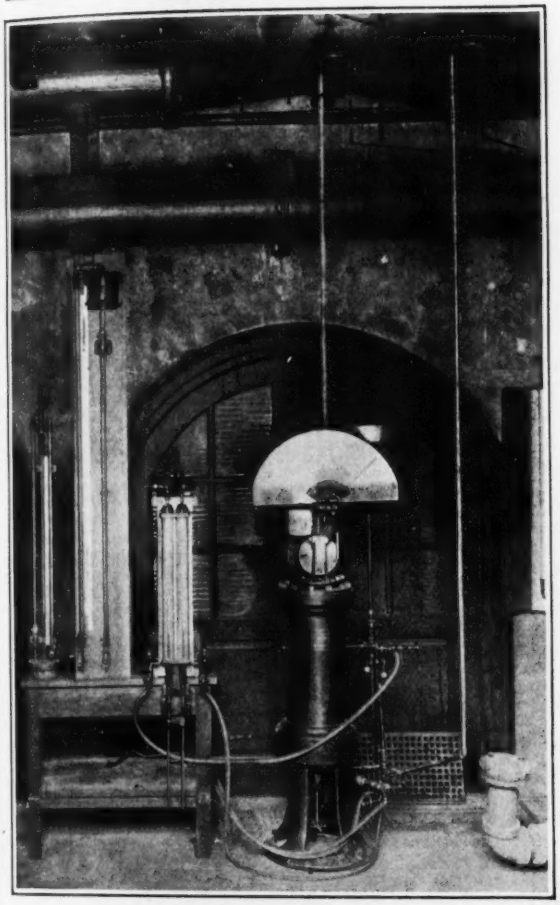


FIG. 2—LABORATORY SET UP FOR SIMPLEX METER TEST

oratory test) and the data for Fig. 1 obtained by revolving the disc ten revolutions, corresponding to five hours, and taking the readings of the totalizer before and after turning.

The computed discharge was obtained from the ordinary Venturi formula altered to give pounds in 5 hours is

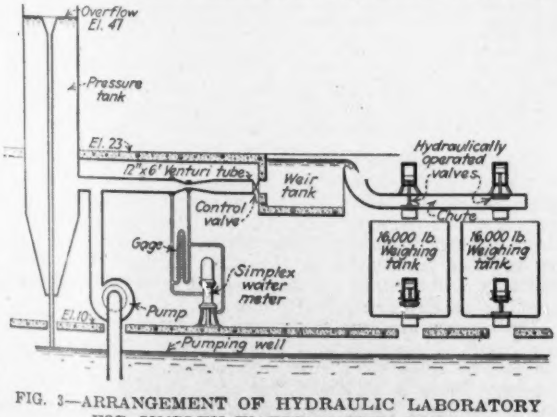


FIG. 3—ARRANGEMENT OF HYDRAULIC LABORATORY FOR SIMPLEX WATER METER TEST

$$\text{Pounds in 5 hr.} = (60 \times 60 \times 5 \times 62.31) \times \left(CA_2 \div \sqrt{\left(1 - \frac{A_2}{A_1}\right)^2}\right) 2gh$$

$= 1{,}820{,}300\ C\ \sqrt{h}$, in which A_1 = area of main in sq.ft.; A_2 = area of throat in sq.ft.; h = the Venturi head; c = the coefficient from the curve in *Engineering News-Record*, Sept. 23, 1920.

The hydraulic laboratory test was made as follows: the Simplex meter was connected to the 12x6-in. Venturi tube as shown in Fig. 2. One of the three gages shown was also connected, the one used depending on the magnitude of the head. The rate was fixed by means of the control valve shown in Fig. 3 and kept constant by means of an overflow in the pressure tank. The water after passing through the Venturi tube and the control valve passes over the weir into the chute over two 16,000-lb. weighing tanks. All the water discharged throughout a run was weighed by alternately filling and emptying the 16,000-lb. tanks shown in Fig. 3, the quantity varying from 400,000 to 40,000 lb. per test. Time was taken with an accurate stop watch and the Venturi head read accurately. Simultaneous readings were taken on the totalizing device of the meter from which data Fig. 2 was constructed.

Inspect Lake Intake from Ice

EXAMINATIONS of the submerged water intake of the Western New York Water Co. in Lake Erie, a mile from shore, are made by a diver in the winter from the ice. The intake can be carefully located by ranges set on shore, the diver and his equipment can be taken out over the ice and the diver can descend immediately over the top of the intake.

A pump supplying air to the diver is kept in the small house shown in the picture and the air is heated there. This warm air fills his suit and enables him to work freely in the cold water.

At the time of the last examination nothing was found especially wrong with the intake, but observations were made to determine what steps had to be taken to replace the old intake installed in 1900.

DIVER DESCENDING THROUGH ICE TO WATER INTAKE

In carrying on this work, the water company was the first party to run a Ford car out on the ice. Now the local fishermen in the vicinity, who had in the past been depending on dogs to pull sleds when they went up the lake five or six miles, have turned to the use of Ford cars for this purpose.

This work was carried out under the direction of H. F. Huy, general manager of the Western New York Water Co., furnishing water to the suburban area of Buffalo.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Eliminating Grade Crossings by Relocation

Sir—C. F. Loweth's letter published in your issue of April 3, p. 583, makes a number of points that ought to be noticed. One of these is in the fourth paragraph where the following statement is made:

> In most cases coming under the writer's observation the highway relocations accomplish much more than the elimination of a railroad crossing. In almost every case which has come under my observation, the portion of the old highway to be abandoned contained a great many objectionable features in addition to the grade crossing, such as sharp and blind turns, steep grades, narrow and weak bridges, insufficient drainage, low and narrow roadways, poor surfaces, or other objectionable features. The relocated highway eliminates all these defects fully and usually substitutes for an unimproved country road a first-class highway. This is quite proper, assuming that the cost is justified and properly apportioned. But right here comes the unfairness of the contention of the highway authorities, in many places, in that they apportion to the grade crossing elimination capitalization for separating or protecting the crossing which in some cases may be equal to or even exceed the total cost of the relocation. This practice is manifestly unfair. Obviously the relocated highway, with its improved alignment, shorter distance, better grades and drainage, better surface, ample and safe culverts and bridges, the elimination of dangerous turns and other similar betterments has a very considerable increased value to the public.

What Mr. Loweth refuses to take into account is that in all of these cases grades and alignment that would be entirely acceptable from the highway standpoint could be secured by very minor relocations constructed at a small fraction of the cost of the major relocation required to do away with the railroad grade crossings. In my experience it has invariably been true that the railroads have fought apportionments just as stubbornly in cases where the alignment and grades on the old road were equal to those on the new as they have in cases where the alignment and grades on the new road were superior. And Mr. Loweth forgets entirely to take into account some relocations that have removed trunk highways from grade crossings where the railroad company has not been asked to pay anything.

In a case recently decided in the Circuit Court of Dane County where the Railroad Commission's order apportioning the cost of a highway relocation was resisted by a railroad on precisely the argument advanced by Mr. Loweth, the court said:

> The Court recalls no similar case in this court where so many grade crossings were involved, or where so large benefits were conferred on the railroads by a single relocation project.

And in another case the same court said:

> When the improvements which are involved in this and its companion cases are viewed as a whole, it appears with certainty that the new highway in each case was opened for the primary purpose of diverting a considerable part of the traffic from the old road and thereby protecting the public from possible injury.

In the next paragraph Mr. Loweth says:

> The difficulty with many relocations is that they only partially divert the traffic from existing crossings and in many cases the traffic is not diverted sufficiently to justify the old crossings without some form of protection.

But the railroad companies have fought just as strenuously where actual traffic counts show that the amount of traffic diverted was in excess of 95 per cent. In one case where it was suggested that the Railroad Commission might actually close a crossing, the railway attorney protested against this closing and challenged their right to do so.

In the sixth paragraph we find the following:

> How dangerous is a railroad grade crossing? The writer does not desire to be understood as claiming that there is no element of danger, nor even that it is negligible, but he believes the danger element is too often overstated. Especially is this true relative to the many other dangerous conditions, incident to highway traffic. Narrow roadways, sharp and blind turns, roadway obstructions, restricted bridges and culverts, reckless driving and glaring headlights are all dangerous conditions which take a large toll of injuries, life and property. Highway authorities seem to be largely indifferent to these evils, the correction of which would bring a much more prompt and larger degree of safety, and at much less expense than can possibly occur with any program for grade crossing elimination.

The last sentence contains a statement which is the exact opposite of the facts. Any one who is at all familiar with work of highway engineers in state departments knows that the first consideration in making road plans is to get a road that will be as safe as possible. But the question is asked, "How dangerous is a railroad grade crossing?"

Though an exact answer is difficult, it is plain that the railroad grade crossing is the most dangerous place in the highway.

Beginning in May, 1922, the State Highway Commission of Wisconsin asked the patrolmen on the state trunk highway system to report all accidents. The number reported between May 1, 1922, and August 31, 1923, is as follows:

Total number of accidents reported	2,083
Number of people killed in these accidents	176
Number of people seriously injured	562
Number of people slightly injured	1,796
Number of accidents at railroad grade crossings	102
Number of people killed in these railroad grade crossing accidents	26
Number of people seriously injured in these railroad grade crossing accidents	43

The total mileage maintained on the state trunk highway system was 7,460 miles with 865 grade crossings. If a distance of 20 ft. is allowed for each, the total mileage on the highway system which can be said to be on railroad grade crossings is 3.28 miles. It is, of course, to be expected that there will be more accidents on the 7,456.72 miles of state highway off grade crossings than on the 3.28 miles on grade crossings. The true basis of comparison is the number of accidents per mile of state highway off railroad grade crossings and the number per mile of state highway on grade crossings. The following figures are fragmentary and a comprehensive comparison cannot be made until records extending over a much greater time and taking in a much larger area are available. But as far as they go they are interesting.

Total number of grade crossings on state highway system	865
Total length of grade crossings at 20 ft. each	3.28 miles
Total mileage off grade crossings	7,456.72
Total accidents per mile of grade crossings	31.1
Total accidents per mile off grade crossings	0.266
Serious accidents per mile on grade crossings	13.1
Serious accidents per mile off grade crossings	0.070
Fatal accidents per mile of grade crossings	7.93
Fatal accidents per mile off grade crossings	0.020

Ratio of accidents on railroad grade crossings to equal distances on other parts of highway system:

All accidents—117 times as numerous.
Serious accidents—187 times as numerous.
Fatalities in accidents—396 times as numerous.

This is sufficient to indicate why the highway departments of all the states are giving much attention to the improvement of safety at railroad grade crossings. That accidents are numerous all over the highways means that there is much to be done everywhere, and it is being done, as any one familiar with the work of the various state highway departments can demonstrate to the complete satisfaction of any fair-minded person.

Mr. Loweth proposes to dismiss the entire subject by the enactment of statutes that would require drivers of automobiles to come to a full stop before crossing railroad tracks. There is no doubt that such statutes, if observed, would do much to do away with railroad grade crossing

accidents, and all of us who have given the subject thought are in thorough sympathy with every reasonable method by which all accidents, on the highways and elsewhere, can be abated. But such a statute as he recommends would be exceedingly difficult of enforcement; and its principal effect would be to relieve the railroad companies of all responsibility in the matter of grade crossing improvements. This is what they are really after, to avoid the legal liability resulting from accidents, and the expense involved in safety work. The public's concern is to avoid the accidents, and the attendant loss of life and human suffering.

The railroad grade crossing problem cannot, however, be dismissed by this gesture. Public opinion favoring improvement of safety at grade crossings is growing stronger every day, and unless the railroads show some disposition to meet the public a part of the way, they face some real trouble. If they continue to resist anything and everything as they are now doing, the pressure thus held back will probably force extreme and unfair legislation. The only way to relieve it is to meet the public openhandedly on meritorious projects and to spend in the actual execution of safety work some of the money now being paid high-priced legal talent in the effort to stave off these improvements.

M. W. TORKELSON,
Engineer-Secretary, Wisconsin Highway Commission.
Madison, Wis.,
April 19.

Is Runoff Dependent on Precipitation?

Sir—Although Robert E. Horton has corrected in your issue of March 20, p. 502, the gross miscalculations of runoff as given in his paper on "Precipitation and Runoff near the Continental Divide" in your issue of Feb. 28, p. 356, he still maintains that his main argument has not been altered: namely that the high watersheds near the Continental Divide in Colorado yield more water in runoff than they receive in precipitation. To further establish this point he assumes that measured runoff should be corrected by 14.9 in., the difference between precipitation and runoff as found by careful measurements at Wagonwheel Gap, Colo. There is every reason to believe that the evaporation loss is here considerably greater than would be the rule for the larger watersheds dealt with, which extend well above timber line in most cases.

The weak point of Mr. Horton's argument, however, is that neither he nor anyone else has any precise knowledge of the amount of precipitation occurring at the high altitudes near the Continental Divide. It would have been only fair to Mr. Follansbee to have stated that the precipitation records used by Mr. Horton were not taken from Water Supply Paper 500. The figures used by Mr. Horton are apparently antiquated and very questionable. For example, I am unaware that any official precipitation record was ever taken at Manitou (El. 6,500 ft.). Certainly the amount could not be 31.2 as given by Mr. Horton. Our latest compilation for stations in the Pike's Peak region gives:

	Elevation, Ft.	Precipitation, In.
Colorado Springs	6,098	14.32
Fremont Experiment Station	8,836	21.77
Lake Moraine	10,265	24.59

Presumably Mr. Horton's record for Pike's Peak (El. 14,109 ft.) is the one obtained in the 80's, giving 20.55 in., which would agree with those given above. From these records it is apparent that the average for elevations above 9,000 ft. must be about 25 in. The runoff for the four streams in this locality, as given by Follansbee, is 9 in. or 16 in. less than the precipitation.

If the twenty-two watersheds given by Follansbee for both sides of the Divide, which are 95 per cent or more above 9,000 ft., are considered, their mean runoff is 19.8 in. From extended study of available records and of snow conditions above timber line I do not doubt that the territory of these watersheds receives at least 33 to 35 in. of water per annum. While Crystal River at Marble, with 43.8 in. runoff, exceeds this estimate, there may be special considerations affecting the flow of that stream. Until we have real records of precipitation for the high altitudes, I can not see the scientific or practical value of discussions such as Mr. Horton has indulged in.

C. G. BATES.
Fremont Experiment Station,
Colorado Springs, Colo.,
April 5, 1924.

[Mr. Horton submits the following reply to Mr. Bates' letter.—EDITOR.]

Sir—Mr. Bates appears unfortunately to have missed the main point of the writer's discussions in *Engineering News-Record*, Feb. 28, 1924, p. 356 and March 20, 1924, p. 502. The writer did not maintain, as Mr. Bates alleges, "that the high watersheds near the Continental Divide in Colorado yield more water in runoff than they receive in precipitation." The writer's proposition is very different. It is that more precipitation is required to account for the measured runoff plus a reasonable allowance for water losses than is actually recorded at the available rainfall stations, even after correction for elevation. There is evidently some factor which makes the true precipitation on these small areas greater than the apparent precipitation. Mr. Bates seems to be of the same opinion since he gives his view as to the actual precipitation in this region as being at least 33 to 35 in. per annum as against recorded precipitation around 25 in. If, as the writer suggested, local horizontal snow transport against slopes, or "roof effect," is the missing factor, then averages of many basins such as Mr. Bates uses do not afford an answer to the problem. The snow effect is bound to be local and may even rob one small basin of what it gives another. Water losses vary slowly with several factors, but principally with precipitation. Water losses at Wagonwheel Gap are known; those for the other basins considered are not certainly known. Wagonwheel Gap water losses were taken as illustrative and not as an actual measure for the other areas. However, there is certainly no proof, nor has Mr. Bates pointed out any valid reason for belief, that the water losses at Wagonwheel Gap are "considerably greater" than on the other areas considered. The average elevation of the Wagonwheel Gap drainage basins is about 10,000 ft. and of the other areas about 10,500 ft. If the precipitation on these other areas is 33 to 35 in., as Mr. Bates avers, as against 21 in. at Wagonwheel Gap, then the water losses for these other areas should certainly be greater instead of less than those at Wagonwheel Gap.

The rainfall records used by the writer were all official U. S. Weather Bureau records. Those used in the table of comparison of rainfall and runoff (*Engineering News-Record*, March 20, 1924, p. 502) were for periods as nearly as possible contemporaneous with the runoff records. They were therefore neither "antiquated" nor "very questionable." Mr. Bates has evidently confused the records cited by the writer as showing the greatest recorded rainfall in the locality with those used in making up the writer's rainfall-elevation curve and the figures given in the table referred to.

Mr. Bates will find the record at Manitou in fragmentary form in the official publications of the U. S. Weather Bureau. It is a short record but was used in the paper merely to illustrate the highest rainfall reported at any station in this locality, and for no other purpose. Mr. Bates states that the rainfall cannot possibly be as much as 31.2 in. at Manitou. Jupiter Pluvius is capable of many things, but even if this record does show more than the true rainfall it only enforces the writer's proposition that the measured rainfall at any adjacent station is not adequate to account for the measured runoff plus reasonable allowance for water losses.

The rainfall records used by the writer were not credited to nor furnished by Mr. Follansbee. Mr. Follansbee has, however, kindly submitted (by letter) a rainfall-elevation curve for the east slope of the Rocky Mountains near Pike's Peak, which is in very close agreement with that of the writer for elevations around 10,000 ft.

Practicing engineers often cannot wait to get ideal data. They must use what is available. The writer's paper was directed toward suggesting better methods of scientific approximation in such cases as a substitute for guesswork or arbitrary assumption.

ROBERT E. HORTON,
Albany, N. Y., April 26, 1924.. Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Preliminary Plans for the electrification of the Baltimore & Ohio R.R. lines on Staten Island have been approved by the Public Service Commission and the Transit Commission of New York State.

An Airplane Survey of the Little River catchment area of the Springfield water-works was completed recently by the Air Service Corporation. Elbridge E. Lockridge is chief engineer of water-works.

The Ann Arbor R.R. Will Build a 16-mile extension into Flint, Mich., according to a statement by Newman Erb, president. Surveys for the line have already been made.

The British-Columbia Electric R.R. Co. will start the enlargement of its Alouette power development in the near future by the construction of the Alcuette-Stave tunnel. The tunnel will be 3,400 ft. long and 14 ft. in diameter.

The City Commission of Orange, N. J., on May 6, voted to apply to the Passaic Valley District Sewerage Commission for admission to the Passaic Valley trunk sewer, sewage-works and outlet tunnel into New York Harbor. All or practically all the other municipalities included in the enabling act have joined in the project heretofore.

New York State's Annual Conference of Health Officers and public health nurses will be held at Saratoga Springs, N. Y., probably June 24-26, and the program will probably include a special session for city health officers under the auspices of the State Department of Health and the State Conference of Mayors. The effect of "home rule" legislation on public health administration is one of the tentative subjects for discussion.

To Aid National Development, and to avoid millions in waste, passage of the Temple Bill, providing for the complete topographic mapping of the United States, is urged by the American Engineering Council. The Council has placed before President Coolidge a resolution adopted by its Administrative Board favoring the Temple measure, new pending in Congress, and which, it was said, has the approval of Secretary of the Interior Work.

The Puget Sound Power & Light Co. has filed a declaration of intention with the Federal Power Commission to construct a 210-ft. dam, to develop 20,000 hp. on the Baker River, a tributary of the Skagit River, near Seattle. A declaration of intention for two power sites on the Strong River in Simpson County, Miss., has been filed by M. L. Culley of Jackson, Miss. The dams will be 50 and 30 ft. high.

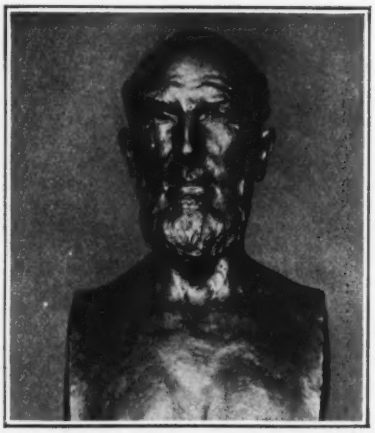
Bust of James Buchanan Eads Unveiled in Hall of Fame

The bust of Capt. James Buchanan Eads, the gift of the American Society of Civil Engineers, was unveiled in the Hall of Fame at New York University on May 13, 1924. The presentation of the bust was by George S. Davison, vice-president of the society, the unveiling was by James Eads Switzer, a grandson of Capt. Eads, and the address was by Dr. George F. Swain, professor of civil engineering at Harvard University and past-president of the American Society of Civil Engineers. Capt. Eads was elected to membership in the Hall of Fame in 1920.

Capt. Eads was born at Lawrenceburg, Ind., May 23, 1820. He designed and built the first great steel arch bridge—the bridge across the Mississippi River at St. Louis which now bears his name. For many years he was engaged in raising sunken vessels and removing obstructions from the Mississippi River. At the outbreak of the Civil War he undertook to design and build iron-clad gunboats for the federal government. His greatest work was that of opening the Mississippi River to deep draft vessels by the use of jetties to control the flow of the river and force it to scour out its own channel, a work undertaken in the face of much opposition and at the expense of himself and his associates, no payments being made by the government until the work had proved successful.

Capt. Eads died at Nassau, N. P., Bahamas, March 8, 1887, while promoting the great undertaking of building a ship railway across the Isthmus of Tehauantepec, Mexico.

Engineer in the Hall of Fame



Bust of James B. Eads, which was unveiled in the Hall of Fame, New York University, May 13.

U. S. Chamber of Commerce Holds Annual Session

Urges Continuance of Main Principles of Transportation Act of 1920—Other Recommendations

Approval of the War Department's plan of preparing for industrial mobilization in time of war, urging increased federal aid in building transcontinental highways, recommendation that the main principles of the Transportation Act of 1920 be continued, approval of the Mellon tax plan and disapproval of the soldier bonus were a few of the principal recommendations made at the annual convention held last week at Cleveland, of the Chamber of Commerce of the United States.

The chamber acted upon 26 resolutions which resulted from reports of the various standing committees and from discussions on the floor of the convention. These resolutions were offered in addition to voluminous reports upon all phases of commercial and industrial relations both national and international. Though a few of the speeches were more or less scientific or technical, the mass of them had to do purely with industrial problems.

Chief among the resolutions interesting to readers of *Engineering News-Record* were those having to do with transportation, trade-association activities, industrial relations, industrial mobilization, and various resolutions concerning taxation.

More Aid for Highways

Concerning highway construction, the chamber passed a resolution recommending that Congress consider an amendment to the present federal laws which would permit the completion of transcontinental highways at an early date. This resolution took cognizance of the fact that delay was principally due to the inability of certain Western states to finance their proportion of transcontinental construction on the basis of present federal appropriations.

The important principles of the Transportation Act of 1920 should be continued without change until there has been further experience, was the attitude taken by the chamber expressed by a referendum of the membership. Violent opposition was registered against what is known as the Howell-Barkley bill now before the House of Representatives, which would eliminate representation of the public as a party in interest in the determination of controversies between railroads and their employees. This bill also would, the chamber believed, establish closed-shop conditions on all railroads by law, a principle against which the chamber registered objection in another resolution.

The chamber approved the functions

(*Continued on p. 875*)

Preliminary Program of Testing Materials Announced

The preliminary program of the twenty-seventh annual meeting of the American Society for Testing materials has just been issued. The meeting will be held at Haddon Hall, Atlantic City, June 24-27.

The business before the meeting has become so great that it has become necessary to have simultaneous sessions practically throughout the week. The afternoon and evening of Monday, June 23, and the morning of Tuesday, June 24, are to be devoted to committee meetings. The simultaneous sessions start Tuesday afternoon and continue through Tuesday evening. There are simultaneous sessions again Wednesday morning, the afternoon being given over to recreation and committee meetings, with the presidential address in the evening, followed by an informal dance and smoker. Thursday morning has duplicate sessions, Thursday afternoon committee meetings, Thursday night a single session. There are duplicate sessions on Friday morning and evening, with golf and tennis tournaments in the afternoon.

There will be a symposium of corrosion-resistant, heat-resistant, and electrical-resistance alloys. Other papers include "The Strength of Structural Timbers: Influence of Defects and a Discussion of Variability," by J. A. Newlin and R. P. A. Johnson; "Some Engineering Applications of High Chromium Iron Alloys," by C. A. MacQuigg; "Types of Apparatus Used in Testing the Corrodibility of Metals," by H. S. Rawdon, A. I. Krynitsky and W. H. Finkeldey; "High Tensile Strength with Low-Carbon Steels," by R. H. Smith; "Accelerated Wear Tests of Concrete," by F. H. Jackson, Jr.; "Methods of Securing Samples of Completed Pavements with Reference to the Determination of the Quality of the Cement-Concrete Foundation," by E. E. Butterfield; "Direct Measurement of Poisson's Ratio for Concrete," by A. N. Johnson; "Accelerated Fatigue Tests and Some Endurance Properties of Metals," by D. J. McAdam, Jr.; "Influence of Aggregates Upon Shrinkage of Mortar and Concrete," by Cloyd M. Chapman; "Calcium Chloride as an Admixture in Concrete," by D. A. Abrams, and "Recent Investigations on Cast Iron for Pipe," by Richard Modenke.

The last item on the program of one of the simultaneous sessions Friday night, the last day of the meeting, is the report of the Joint Committee on Concrete and Reinforced Concrete.

New Railroad Projected

A charter has been granted to the Florida Western & Northern Ry., a corporation with a capital of $5,000,000, for the purpose of constructing or acquiring, of operating and maintaining a line of railroad from a point near Coleman in Sumter County to one or more of the following points: Stuart, Jupiter, and West Palm Beach, a distance of approximately 205 miles.

Three Indicted in Portland Bridge Tangle

A grand jury sitting in Portland, Ore., May 10 indicted two county commissioners, Charles Rudeen and Dow V. Walker, for "receiving and agreeing to receive a bribe" and at the same time indicted Robert E. Kremers, of Hedrick & Kremers, bridge engineers for "bribing and offering to bribe a public official." The indictments result from alleged irregularities previous to the opening of bids and award of contracts on the construction of the Burnside, Ross Island and Sellwood bridges across the Willamette River. The grand jury will next investigate alleged collusion in the award of contracts (see *Engineering News-Record*, April 24, p. 740.)

More Storage and Another Unit for Caribou Project

Work has just been completed on the Butt Valley dam of the Great Western Power Co. in California whereby the original small dam has been made 80 ft. high. The work extended over a period of eight months and involved the placing of 300,000 cu.yd. of material by the hydraulic sluice method. As reconstructed the dam is 1,200 ft. long and stores 50,000 acre-ft. as compared to the previous reservoir capacity of 5,000 acre-ft. This reservoir and Lake Almanor, which has a capacity of 295,000 acre-ft., supply the Caribou hydroelectric project on Feather River.

Another recent addition to the Caribou Project was a third unit in the powerhouse, put in service April 1. This addition, the same as the previously installed units, is a 32,000-hp. double-overhung impulse wheel operating under a head of 1,008 ft.

American Society for Testing Materials Nominates

By unanimous decision of the nominating committee, the following nominations have been made for officers in the American Society for Testing Materials:

President, F. M. Farmer, chief engineer, Electrical Testing Laboratories, New York City; vice-president, J. H. Gibboney, chemist, Norfolk & Western R.R., Roanoke, Va.; members of the executive committee, William Campbell, Howe professor of metallurgy, School of Mines, Columbia University, New York; A. E. Jury, manager, textile section, United States Rubber Co., New York; Anson Marston, dean of division of engineering, Iowa State College; John A. Matthews, vice-president in charge of metallurgy, Crucible Steel Co. of America, New York. The by-laws provide that further nominations signed by at least twenty-five members may be submitted to the secretary-treasurer in writing by May 20, these nominations to be issued to the members between May 20 and June 1.

N. Y. Port Authority Given Power to Subpœna

Compulsory Electrification Extended—Oswego to Develop Power—Other Bills Signed

Governor Smith of New York has signed the Walker bill which confers upon the Port Authority of New York power to conduct investigations for hearings to facilitate determination of economic practicability of any step in a comprehensive plan of development. For this purpose, only, the commission shall have jurisdiction of all persons or corporations residing in or acting under laws for owning property within State. The jurisdiction conferred obviates the necessity of going to the Interstate Commerce Commission for the settlement of many minor matters.

Other bills signed by Governor Smith include one wherein compulsory electrification of railways within the city of New York is extended to include the cities of Mount Vernon and Yonkers. The original bill, passed in 1923 required the electrification of all railroads within the city limits by January, 1926. The additional electrification covers the Putnam division of the N. Y. Central.

The bill authorizing the city of Oswego to develop and operate power without the permission or approval of the public service commission, notwithstanding the provisions of the conservation law or any other provision of any statute of the state of New York has also been signed by the governor. He has also signed an amendment to the conservation law taking out of the law the provision that a municipality in order to develop and sell electrical current in competition with an existing public utility must obtain the permission of the service commission.

Creation of dock districts in towns and the financing of their construction and maintenance in much the same manner as the New York Port Authority and river-regulating districts function is authorized under the bill which Governor Smith signed May 8. The bill is intended primarily to encourage the construction of additional docking and pier facilities along the line of the barge canal but will affect all inland navigable waters of the state.

Increase Building Permit Fees

By action of the city council of Cincinnati, building permit fees in that city have been increased, and different fees have been established for different types of buildings. Heretofore the fees have been uniform for all types of buildings, and amounted to $2 flat fee plus 25c. per 1,000 cu.ft. of volume of building. The new fees are: For minor garages, $2, plus 30c. per 1,000 cu.ft. of volume; for small residences (not over 25,000 cu.ft.), $4, plus 30c. per 1,000 cu.ft.; for all other buildings, including apartment houses and large residences, $5, plus 30c. per 1,000 cu.ft.

These changes have been made, according to George R. Hauser, commissioner of buildings, to cover the increased cost of plan examination and inspection. There is no increase in the fees for alterations or additions.

Pork-Barrel Politics Attack Reclamation Bureau

Acceptance by Government of Projects of Doubtful Value Being Urged—Mead's Work Constructive

Washington Correspondence

Acceptance by the government of several reclamation projects of doubtful value is being urged with unusual vigor at this time. All the tricks of log-rolling and pork-barrel procedure are being employed. The Reclamation Act in the past has been used largely to rescue bankrupt enterprises. Apparently the projects which will be urged most strongly in the future will be those which private enterprise has started and has been unable to complete or to conduct successfully. In certain instances, such projects are economically sound and the whole difficulty is the lack of money, but the strongest efforts seem to be to unload on the government the sourest sort of lemons. They either cost more than the water is worth or are lacking in some other item essential to success.

No Secretary of the Interior or Commissioner of Reclamation can withstand the pressure which can be exerted in these cases unless there is aroused an active public interest outside the arid region to counteract political influence which frequently is used unscrupulously in dominating the selection of projects. The prospects are that no small proportion of the time and energy of Dr. Elwood Mead, the new commissioner, necessarily will be consumed in efforts to prevent the acquisition of questionable projects.

Action on Existing Projects

In the matter of the existing projects, constructive work has already been initiated for the improvement of operating conditions. Some 11,000 or 12,000 farms on reclamation projects have been abandoned during the several years of depression, an aggregate of perhaps 500,000 acres. In order to secure accurate information as to why these farms have been abandoned, he has sent out a questionnaire which will make possible a much more accurate analysis of that situation. He is asking if the departure of the settler was due to lack of drainage, poor soil, lack of capital, lack of industry or lack of market. He is asking as to the distance from markets, the condition of roads, school and church advantages, the amount of mortgage, the rate of interest, tax payments, price of land, terms of payment, and other questions. In connection with the consideration of abandoned farms, it is significant to note that the return movement already has set in. The settlers who left frequently are finding that they exchanged a bad situation for one that was worse and have decided to return and try again.

Consideration also is being given the situation which confronts the settlers who have stayed with their farms. A portion of Dr. Mead's questionnaire deals with facts as to occupied farms: indebtedness, rate of interest, income, capital needed and the like.

Canada Names Engineers For St. Lawrence Board

The Canadian government has appointed D. W. McLachlan of the Department of Railways, O. O. Lefebvre, chief engineer of the Quebec Streams Commission, Montreal, and Gen. C. H. Mitchell of Toronto, as Canadian representatives on the Joint Engineering Board in connection with the St. Lawrence Waterways Project. Mr. Lefebvre and Gen. Mitchell will act as technical officers of the commission.

A national advisory committee on the project has also been appointed consisting of Hon. George P. Graham, Minister of Railways and Canals, chairman; Thomas Ahern, Ottawa; Hon. W. E. Foster, St. John, N. B.; Beaudry Leman, Montreal; Edward D. Martin, Winnipeg; Dr. W. L. MacDougall, Montreal; Sir Clifford Sifton, Toronto; Major-General John W. Stewart, Vancouver; and Hon. Adelard Turgeon, Quebec.

The investigation of the possibilities of carrying out the St. Lawrence waterways project will include such points as whether or not the work would materially affect the level of the St. Lawrence or other navigable waters, whethers the cost of the scheme can be kept within reasonable bounds and what advantages accruing to either country might influence the apportionment of the cost.

Governor Smith Vetoes New York Highways Bill

Upon the advice of Col. Frederick Stuart Greene, state superintendent of public works, Governor Smith on May 6 vetoed the highway bill, which added approximately 800 miles to the highway system of the state at an outlay of approximately $40,000,000.

In vetoing the measure, Governor Smith decried the system of laying out highway routes by legislative enactment. He asserted that "It cannot be denied that they are laid out as a matter of political favor. Of course, it is not a legislative function," continued Governor Smith. "It is administrative and can best be carried out in the interests of the state by the engineers employed by the state.

Governor Smith tabulated several reasons why the bill was vetoed, among them being the fact that the assembly added 792 more miles, of which 31 miles are referred to in the highway department as dead-end roads; that twenty different roads totaling 154 miles were laid out parallel to roads already improved; that four roads totaling 119 miles were added in sparsely-settled sections of the state, which no engineer of the highway department would be prepared to say should now be any part of a comprehensive system. Governor Smith asserted that in a certain section of the state roads were added against the unanimous decision of the advisory committee, and in at least one instance the change was made by the assembly not only against the advice of the committee but over the unanimous protest of the local board of supervisors in the counties affected.

Motorists in Tunnel Overcome During Traffic Blockade

Traffic congestion in the Liberty tunnels, Pittsburgh, on May 10 resulted in a number of persons being overcome by the effect of a high concentration of automobile exhaust gases. Fire Department and Bureau of Mines rescue crews cleared the tunnels and revived those who were overcome. No serious after-effects were reported. The accident occurred under conditions of abnormally heavy vehicle traffic due to a general strike of street-car employees.

The tunnel has been in service for several months in spite of the fact that its ventilating machinery has not yet been installed. It has been operated under restricted traffic and with constant check of air conditions by analysis to determine the carbon-monoxide percentage. Representatives of the Bureau of Mines, Pittsburgh station, have been constantly on duty in the tunnel to watch the air condition. A normal carbon-monoxide content of 4 parts in 10,000 is considered permissible, but when this amount is exceeded traffic is reduced. The variations of carbon monoxide depend not only on the amount of traffic but also on the direction of the wind, which may assist or counteract the effect of the air current due to the movement of the vehicles. The tunnel consists of two separate tubes.

One previous gas poisoning accident was reported from the tunnels, a week previous to the one just noted. A pedestrian was found in the tunnel in semi-unconscious condition, apparently having gone into the tunnel for shelter from rain and having remained too long at a time when the carbon-monoxide percentage was high because of wind against the direction of traffic in the particular tube. He was readily revived.

Direct-Oxidation Sewage-Works at Phillipsburg in Question

The New Jersey State Board of Health on May 6 passed a resolution by a unanimous vote directing the town of Phillipsburg, N. J., to discontinue the occasional bypassing of raw sewage into the Delaware River and notifying the town to show cause at the next meeting of the board why (1) previous permits for sewer extensions granted by the board should not be rescinded and (2) why the town should not be required to build additional sewage-treatment units, of some standard type, that will prevent the pollution of the Delaware River in accordance with the board's adopted standard for that stream. The action was based on reports made to the board by its engineering division to the effect that on 28 different occasions in the recent past raw sewage had been bypassed into the river contrary to the chancery court decree under which Phillipsburg was required to build works. The works already provided are of the direct-oxidation type and were built subject to final approval by the board after test. This approval has never been given. During the meeting on May 6, given.

Mattress Holds River in Attack on Alton R.R.

Emergency Measures Resist Sudden Diversion of Missouri That Threatens Main Line

Emergency measures were successful last week in resisting a sudden diversion of the Missouri River which threatened to breach the main line of the Chicago & Alton R.R. near Glasgow, Mo., where the railroad crosses the river. For ten years the channel of the river at Cambridge Bend, immediately west of Glasgow, has been about 1,000 ft. from the railroad and held by willow mattress work and retards which have now given way.

For the past two years the U. S. Government authorities, the county authorities and the railroad company have been aware of threatening conditions, but much delay occurred in trying to agree upon proper methods of protection and distribution of cost. Finally, a contract was let for the protection of about two miles of shore line; there was then further delay in assembling equipment and starting the work, but it was believed the contractors would be able to meet the situation and hold the river in check.

Erosion Increased

Erosion increased rapidly, however, and the railroad could not accomplish anything for protective work until the cutting of the bank it had advanced so far that the water front could be reached from the tracks. It was then a matter of taking care of the emergency fast enough to protect half a mile of water front. When within 45 to 80 ft. of the tracks the water was from a few inches to 35 ft. in depth, at which stage it was checked by forming willow mats and heavy rafts of undergrowth lumber weighed down with old car bodies, thus forming a new toe to the bank and stopping erosion caused by the current. Sand bags were used also to load the willow mats until the permanent alignment of the bank could be brought about parallel with the track, after which riprapping was begun, thus permanently loading the mattress. This work was accomplished by two steam wrecking cars on the railroad track and a U. S. Government snag boat working from the river, the railroad placing and sinking sixty-five old car bodies followed by riprap.

By May 11, this emergency work had averted danger not only to the railroad but to a great amount of farm land and property which would have been destroyed if the river had broken through the railroad embankment. This threatened area will now be safe until the contractors can complete nineteen retards on two miles of river front, which is the distance of the shore line of bend in the river. Seven of these retards or jetties, formed of anchored trees (see *Engineering News-Record*, Dec. 15, 1921, p. 966), are now progressing and extend from 50 to 115 ft. into the river, causing the silt to deposit and build up a new shore line. It is expected that this diversion will continue as the retards are extended, throwing the river back to its former position or future permanent channel.

This emergency work was handled under the immediate direction of W. G. Bierd, receiver, and R. A. Cook, valuation engineer, of the Chicago & Alton R.R., the railroad forces being assisted by those of the Wood Brothers Construction Co., contractors for the retards, and the U. S. Engineer Office at Kansas City, Mo.

Anti-Shingle Ordinance Repealed

At the May sixth election the city of Berkeley, Calif., voted to remove the restriction on wood shingles recently put into effect by the city council. The initiative measure proposing to prohibit garbage fills was voted down.

U. S. Chamber Convenes

(*Concluded from p. 872*)

of trade associations and proper dissemination of statistics of an industry as in the interest both of business and of the public, and not constituting a restraint of trade, and urged upon the government department concerned that all possible steps be taken to secure action eliminating the obstacles or uncertainties which interfere with the most effective carrying out of the trade association's functions.

Immigration legislation also received attention. In accordance with recommendations made by its immigration committee, the convention reaffirmed its belief that any quota provisions should be based upon the census of 1910 and that the present extension of these provisions should be made for a period not exceeding five years. Certain flexibility in the quota was also recommended so that the immigration might more nearly accord with conditions in the United States. Amendments to the law were also advised so as to reduce hardship upon immigrants.

Other resolutions approved the so-called Dawes and McKenna reports on the rehabilitation of Germany, urged ratification of the Lausanne Treaty securing the United States equal rights with other nations, urged the exclusion of persons undesirable as citizens on a basis of friendly negotiations, opposed governmental agencies for buying, selling, manufacturing, or handling farm products, opposed attempts to deprive the nation's Supreme Court of its power, opposed making tax returns matters of public record, urged a universal budget system, declared for the principle of the open shop, approved workmen's compensation for industrial accidents, and enunciated a set of business principles for the chamber, which code will appear in a later issue of this journal.

At least three men known in construction and engineering circles were given important positions in the chamber's directorate. Ernest T. Trigg, first president of the National Confederation of Construction Industries, was elected director from the Second District; the Committee on Civic Development is headed by Arthur S. Bent, of Bent Bros., contractors, Los Angeles; and the Committee on Transportation and Communication is headed by Carl R. Gray, president of the Union Pacific Ry.

Random Lines

An Engineer Analyzes the After-Dinner Speech

W. D. Sell, of Charleston, W. Va., had to make an after-dinner speech before the A. A. E. a while ago. So he set about in true engineering fashion to analyze the requirements of such a speech. Here they are as he presented them to the diners:

X—Apology—Excuses for your efforts.

Y—Bouquet—Flowers to the distinguished assembly.

Z—Approach—leading up to—

X-1—Subject—be sure title is very heavy.

Y-1—Discussion-A—very little will do, but leading up to—

Z-1—Gag No. 1—which really ought to have some slight connection with subject.

X-2—Discussion-B—See Y-1—leads up to—

Y-2—Gag No. 2—some expert speakers use a pair here.

Z-2—The tapering off—sort of a slide to—

Z-2a—Closing—and for goodness sake—be sure to drag in something relating to "service" or "fellowship" or your name is Dennis, and finish with—

Z-2b—Verse or poem—or wave the flag, and sit down.

It is like one of the federal income tax blanks—all you have to do is to fill in the spaces and the task is over

* * *

The Engineer in Public Life

Dr. Elliot Smith, professor of anatomy in the University of London, says that the first king of Egypt was an engineer. Dr. Smith, who was professor of anatomy in the government medical school at Cairo, and who unwrapped the mummies of thirty kings of the Pharaoh dynasty, told a reporter of the Cleveland *Leader* that agriculture and embalming were the two sciences that laid the foundation for European culture.

"The valley of the Nile was fertile, but as population increased a famine threatened unless some means could be found to increase the yield of barley," he said. "The first engineer was the man who learned how to irrigate, about 4,000 B. C., so the Nile could be made to produce two or three crops of barley a year instead of one that had been watered by the overflow of the stream. This engineer became the king. Early pictures represent the king holding a hoe. Thus the king became the custodian of the food supply and it was in the hope of continuing the benefits he conferred that embalming was used to keep him alive."

The later kings must have gone back, if we are to believe Kipling's verse:

"Who can doubt the secret hid
Under Gizeh's pyramid
Was that the contractor did
Cheops out of several millions."

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Convention, June 18-20, Pasadena, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

The Detroit Engineering Society at its May 9 meeting had an illustrated address by H. M. Lane, president, the H. M. Lane Co., on a comparison of American and European post-war manufacturing conditions.

The Providence, R. I., Engineering Society's speaker May 13, was F. C. Wight, editor of *Engineering News-Record*, who gave a talk on "Engineering as a Changing Art."

The Engineering Society of Western Massachusetts will hold its annual meeting at Hotel Kimball, Springfield, Mass., May 20. Announcement will be made of the officers elected for the coming year, and addresses will be given by General Guy E. Tripp, chairman, Westinghouse Electric and Manufacturing Co., and by Willard Scott, of Brookline, Mass.

Personal Notes

J. A. L. WADDELL, consulting engineer, announces the removal of his office on May 1 from 35 Nassau St., New York City, to 150 Broadway.

L. B. ELLIOTT has been appointed engineer, maintenance-of-way, of the Cincinnati-Sandusky division of the Cleveland, Cincinnati, Chicago & St. Louis Railway Co. and allied lines, New York Central Lines, with headquarters at Springfield, Ohio.

CARL C. WITT, formerly assistant supervising engineer of the Bureau of Valuation of the Interstate Commerce Commission, has been appointed supervising engineer to succeed the late Howard M. Jones. Mr. Witt is an engineering graduate of Purdue University and his early work was in machinery design, followed by a period of service with the Chicago & Northwestern Ry. In 1907 he was made chief engineer of the South Dakota Railroad Commission and made an appraisal of 4,500 miles of steam carries and of utility properties. He also made an appraisal of the Chicago, Peoria & St. Louis R.R. for the attorney-general of Illinois. In 1911 he was appointed chief engineer of the Public Utilities Commission of Kansas. From 1919 on he was, for the Bureau of Valuation, Interstate Commerce Commission, successively district engineer, Western District, member of Engineering Board, and assistant supervising engineer.

H. T. HAZEN, heretofore assistant chief engineer, Central Region, Canadian National Rys., Toronto, has been appointed assistant chief engineer of the operating department with offices at Montreal.

GORDON GRANT, heretofore chief engineer of the highways branch of the Department of Railways and Canals, Ottawa, Canada, has been appointed principal assistant engineer of the Central Region, Canadian National Rys., vice H. T. HAZEN. The position of assistant chief engineer, Central Region, has been abolished.

L. R. PIETZSCH has been appointed city manager of Beaumont, Texas, succeeding GEORGE J. ROARK, resigned. Mr. Pietzsch is an engineering graduate of the University of Texas. For some time he was connected with the Water, Light and Power Co. of Cameron, Texas, but for several years has been president of South Park College, Beaumont, Texas. R. M. FULWEILER will be city engineer and the Terrell Bartlett Engineers, Inc., of San Antonio, have been retained as consulting engineers to the city of Beaumont.

GEORGE L. LUCAS, who for the past sixteen months has been temporarily detailed from the engineering department of the Transit Commission of New York as acting chief executive officer, on May 15 returns to that department, which will be transferred to the City Board of Transportation on July 1. Mr. Lucas will be in charge of administration including the division of materials inspection. He has been a member of the rapid-transit engineering staff for more than twenty years, and for the past decade has had entire charge of the inspection of all materials entering into the construction of the subways built by the City of New York. The Transit Commission has announced the appointment of MAJOR PHILIP MATHEWS, U. S. A., retired, as its chief executive officer.

PEARSE, GREELEY & HANSEN, Chicago, Ill., hydraulic and sanitary engineers, announce the removal of their offices April 15 from 39 W. Adams St. to the Tower Bldg., 6 N. Michigan Ave.

JOSEPH A. GRAFT has been appointed city engineer of Beckley, W. Va. Mr. Graft has been a consulting civil and mining engineer in that section for several years.

MATTHEW B. COWDEN, since 1874 city engineer of Harrisburg, Pa., and the only engineer the city has had since it was made a city in 1874, was recently re-elected to serve another four-year term. Previous to 1874 Mr. Cowden had been "borough surveyor" for one year.

B. S. DICKERSON, heretofore assistant engineer, maintenance-of-way, Cleveland, Cincinnati, Chicago & St. Louis Railway Co., has been appointed office engineer, with headquarters at Cincinnati, Ohio.

J. E. WILLIAMS, senior member of J. E. Williams & Sons of Santa Rosa, Calif., has been appointed city manager of that city succeeding ABNER E. HITCHCOCK, resigned. Prior to entering business for himself, Mr. Williams was employed as a civil engineer by the Northwestern Pacific Railroad Co.

STANTON L. DORSEY, civil and chemical engineer, has resigned from the staff of the R. N. V. Co. of New York and has been elected vice-president of the Knox Engineering Corporation of 120 Broadway, New York, whose president, William J. Knox, was for twelve years scientific consultant to the late George Westinghouse.

J. A. HEAMAN, heretofore assistant chief engineer, Western Region, Canadian National Railways, has been promoted to chief engineer of the Grand Trunk Western Lines of the same system, with headquarters at Detroit, Mich.

EDWARD C. EPPLE, who was an engineer with the Turner Construction Co. for nine years and for the past six years was the chief engineer of the American Concrete Steel Co., has opened an office as engineer and architect at 13 Clinton St., Newark, N. J. He will specialize in factories, warehouses and industrial buildings.

H. W. HARTUPEE, chief structural engineer for Proudfoot, Bird & Rawson, architects, Des Moines, Iowa, with whom he has been connected for the past twelve years, was appointed a member of the Iowa State Board of Engineering Examiners, and will have charge of the structural engineering section of the board.

Obituary

WILLIAM J. BALDWIN, noted engineer and head of the Baldwin Construction Co., died May 7 in a store in Brooklyn, N. Y., at the age of 82 years. He was born on shipboard and was educated in Boston, and began marine engineering work in construction of monitors at Boston during the Civil War. In New York City he specialized as engineer in the steam equipment of large buildings, for which he later became widely known. He had been consulting engineer and designer for the U. S. War College at Washington, for the U. S. immigration station at Ellis Island, and consulting engineer for the Department of Health of New York City. From 1882 to 1889 Mr. Baldwin was an associate editor of *Engineering Record*.

WILLIAM M. STEVENS, civil engineer and architect, prominently identified with the designing and construction of school buildings in Louisiana and other

Southern states, recently died in New Orleans. At the time of his death he was vice-president and general manager of the Rouprich Construction Co., Inc., of New Orleans.

EDWARD F. TERRY, one of the founders of the Terry & Tench Co., engineers and contractors, New York City, died May 12 at his home in Riverdale, N. Y., of heart disease. He was 67 years of age. Mr. Terry is well known because of the important works which his company has constructed, including Grand Central Terminal in New York City and many bridges, among them Manhattan Bridge over the East River. A more extended biography will be given in a later issue.

FRANK G. EWALD, chief engineer of the Illinois Commerce Commission, died suddenly May 1 in Evanston, Illinois, at the home of his daughter. Mr. Ewald was a member of a commission of engineers which during President Roosevelt's administration conducted a survey for the Interstate Commerce Commission relative to automatic block systems, train-control devices and similar railroad problems. Previous to the creation of the Illinois Commerce Commission he was for years chief engineer of the earlier railway and warehouse commission of Illinois.

R. F. HAYWARD, construction engineer and power company manager, died in London, England, April 10. About two months prior to his death, Mr. Hayward was invalidated to London for medical treatment, from Santiago, Chile, where he had been for several years general manager of the Chilean Electric Tramway Light & Power Co. Mr. Hayward was educated in England and came to America in 1889 as general manager of the Salt Lake & Ogden Gas & Electric Light Co. In 1894 he became chief engineer of the Utah Light & Railway Co. From 1896 to 1905 he was general manager of the Mexican Light & Power Co. and in 1909 served in the same capacity the Western Canada Power Co. He remained in this position until 1920 and during this time had charge of design and construction of the Stave Falls plant now operated by the British Columbia Electric Co.

FRANK M. KERR, chief of the State Board of Engineers of Louisiana, died May 5 while on a visit at Bryan, Texas, aged 75 years. Mr. Kerr was noted for his work on the Mississippi levees, where he began in 1871, on graduating from Louisiana State University, as secretary to Colonel C. G. Forshey, chief engineer of the Louisiana Levee Co. In 1876 the State Board of Engineers was created, and Mr. Kerr, starting as draftsman, reached the position of secretary in 1882 and of chief engineer in 1902 and was still in service at the time of his death.

HARVEY S. PATTERSON, manager of the railroad department of the general sales office of the Walworth Manufacturing Co., Boston, died of spinal meningitis at the Norfolk County Hospital, Massachusetts, April 6. He had formerly been connected with the Kewanee works of the Western Tube Co.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

C.I. Pipe, Made in France, Arrives for Use in U. S.

Shipment of 3,000 Tons for Public Service Co. of New Jersey to be Used as Gas Mains

A SHIPMENT of 3,000 tons of 4 and 6-in. cast-iron pipe, manufactured in Pont à Mousson, France, has reached the United States for delivery to the Public Service Co. of New Jersey at Newark, N. J., where it will be used in extending the company's system of gas mains. This is the first time that the New Jersey corporation has entered the foreign market for its pipe. The French pipe has been cast to conform to the specifications of the American Gas Association in practically all details except length. The American standard in this respect is 12 ft. whereas the French pipe is being delivered in 4-m. lengths, equivalent to about 13 ft. 1¼ in. The pipe is designed for laying with the usual type of cement joint employed on gas main construction.

It is understood that the New Jersey corporation secured a price on this shipment which is approximately $12 per ton cheaper than for American-made pipe. On this assumption the saving on the shipment amounted to roughly $36,000. The gas company of the Public Service Co. of New Jersey is a large user of cast-iron pipe, having purchased last year a total of approximately 14,000 tons.

Business Notes

CLIMAX ENGINEERING CO., Clinton, Ia., is planning to supplement its line of gasoline engines with a group of crude oil engines of the Diesel type, with capacity ratings of 50 to 400 hp., depending on the number of cylinders.

C. A. JENNINGS, manufacturers' representative, Chicago, has been appointed representative of the Norwood Engineering Co., Florence, Mass., to handle its business of gravity and pressure filters in the Middle West territory.

BUCYRUS CO., South Milwaukee, Wis., announces that it has appointed the Borchert-Ingersoll Co. of St. Paul as its agent for the sale of small revolving shovels and dragline excavators for the states of Minnesota, North and South Dakota.

THE GUNITE CONCRETE & CONSTRUCTION CO., Kansas City, Mo., has been organized to succeed the Cement-Gun Department of the Pratt-Thompson Construction Co., with which it will be affiliated, having as its officers the same personnel as the former Cement-Gun Department.

Equipment and Materials

Water-Works Equipment

For this, the annual Water-Works Issue of "Engineering News-Record," preceding the convention of the American Water-Works Association in New York, May 19-24, the following descriptions relate to equipment of interest chiefly to the water-works field. Additional water-works equipment news will appear in the May 29 number containing the report of the convention—Editor.

* * *

Reversible Flow Venturi Meter a New Development

A reversible flow type Venturi tube with a registering instrument having two totalling or counter-dials constitutes one of the recent developments made by the Builders Iron Foundry, Providence, R. I. The register also has an indicator dial showing the rate of flow and a chart which records both the rate and direction of flow. In one of the cones of the Venturi tube is mounted a swinging vane which reverses its position when the flow reverses in direction and makes electrical contacts within a watertight case mounted upon the tube. A small electric motor operated through these contacts and mounted on the register connects the high pressure line of the register with the upstream end of the Venturi tube, locates the direction-of-flow pen on the edge of the chart, puts the proper counter into operation, and then automatically locks the mechanism in its operating position by shutting off the current until another reversal of flow occurs.

This electrical method of automatic control of the reversible feature is new and permits the use of this special single registering instrument instead of two separate complete registers formerly needed when hydraulic control was used. As dry cells furnish the small amount of current required, this meter is self-contained and can be operated at any water-works location.

Four of these meters are now being installed at the Baltimore water-works under the supervision of Leon C. Small. Other rapidly growing cities with similar problems of water-works expansion,

according to the Builders Iron Foundry, may use reversible flow Venturi meters to advantage where equalizing reservoirs are used to maintain suitable line pressures during daily fluctuations in demand.

Reservoir Fencing Galvanized After Weaving

For the protection of reservoir and water supply property from careless or deliberate intrusion the American

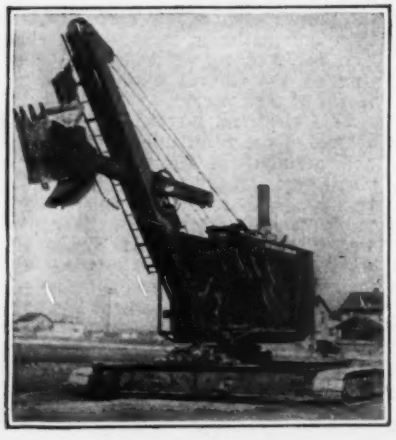
Fence Construction Co., New York, has developed a non-climable fence possessing both strength and durability. The design provides a 2x2½-in. galvanized steel angle post weighing 3.8 lb. per foot, an increase of 10 per cent over the standard of a year ago. As shown in the accompanying illustration this type of fence is normally topped with a barbed wire overhang and the post is shaped to create an integral overhanging arm, thereby eliminating the separate top arms formerly used.

Another feature of the fence is the introduction of chain link wire fabric, galvanized after weaving. Formerly, when the galvanizing process preceded the weaving, slight cracks or abrasions occurred in the zinc coating. Galvanizing by dipping the completely woven fabric in a bath of hot zinc spelter, however, creates a uniform, unbroken protective coating with high resistance to weathering action.

Special Mounting for Steam Shovel Spans Trench

For spanning sewer or water pipe line trenches without the use of mats the Osgood Co., Marion, Ohio, has equipped one of its standard 1¼-yd. continuous tread steam shovels with the special mounting shown in the accompanying photograph. The mounting consists of a steel frame 26 ft. wide overall supported at each side by continuous treads, gear-driven.

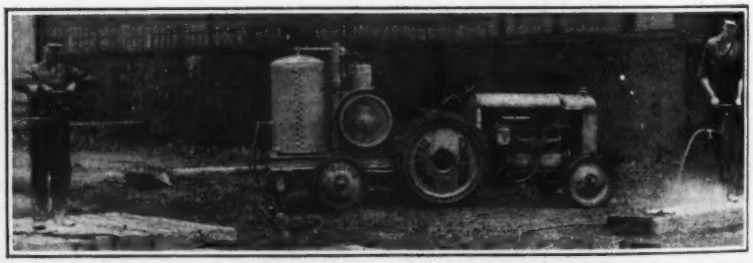
The machine, shipped to Thomas Holahan, Rochester, N. Y., is equipped with a 1-yd. dipper, 25-ft. boom and 18-ft. handle. It has an auxiliary hoisting drum for use as a dragline or clamshell outfit. In addition to the standard equipment, a 34-ft. dipper handle and the special continuous tread mounting were included. The mounting is of structural steel designed for attachment to the regular continuous tread truck frame.



The machine is being used for excavating for 5,000 ft. of 72-in. concrete sewer in Rochester. The cut runs from 16 to 25 ft. in depth, the first 8 ft. being earth underlaid with rock.

Portable Air Compressor Powered by Fordson Tractor

With a capacity of 90 cu.ft. of free air per minute, designed for the intermittent operation of two hand hammer-drills, a new air compressor in combination with a Fordson tractor has been developed by the Curtis Pneumatic Machinery Co., St. Louis, Mo.



The compressor element of the unit is carried on a two-wheel trailer mounting, which may be detached from the tractor, allowing the latter to be used as a haulage unit.

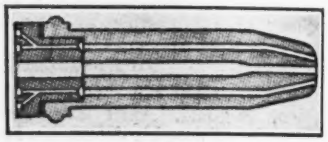
The complete outfit weighs 4,700 lb., has an overall length of 12 ft. 6 in., and a height of about 6 ft. The tractor is the standard Fordson unit with metal wheels, but for city use rubber-tired wheels may be substituted. The compressor is of the single-acting, double-cylinder (6 x 6-in.) water-cooled type, operated by a belt drive from the tractor power take-off. An air receiver in the form of a 47-gal. cylindrical tank is designed for 150 lb. per square inch pressure. The cooling system for the compressor is separate from that of the tractor and involves a water pump and radiator.

The trailer mounting of the compressor is provided with steering mechanism. To eliminate vibration while in use, steady-rests are provided under the rear end of the trailer; they are adjusted to inequalities in the ground level by turning a hand wheel which operates a pair of jacks.

For this compressor-tractor unit the manufacturer suggests the following uses: Supplying air for hand hammer-drills, paving breakers, riveting hammers, drills for structural steelwork, rammers and tampers, compressed-air hoists, sand blasts, stone-cutting tools, quarry tools, rivet forges, clay and coal-mining diggers, pumping water, washing automobiles and trucks by the air-mist system, unloading tank cars, spray painting, and calking pipe.

New Tip for Oxyacetylene Cutting Torches

For use on its oxyacetylene metal cutting torches the Alexander Milburn Co., Baltimore, has introduced a new form of tip, known as the Super Tip, designed to mix the gases thoroughly, preheat the cutting oxygen, and give



added velocity and penetration to the preheating and cutting jets. The tip is provided with a renewable seat which facilitates cleaning and maintenance and cuts down on repair or replacement cost.

The mixture of preheating gases takes place in multiple passages in the renewable seat of the tip. The gases then pass into an annular passage where they are given a swirling motion, after which they are again separated and expanded into enlarged multiple passages leading to the orifices in the tip proper. Here the preheating flames are projected with an increasing velocity inclined toward the high pressure oxygen jet, resulting, it is claimed, in a speedy cut, narrow kerf, and a material saving in gases. The new tip is interchangeable with all sizes of cutting tips on Milburn torches manufactured since 1916.

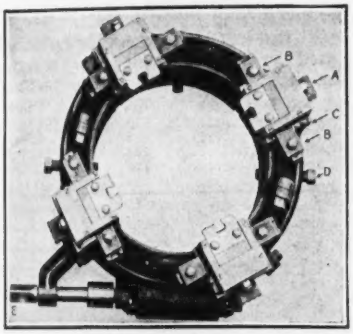
Gate Stands Redesigned

New designs for its hand-operated and electrically operated gate stands have been introduced by the Coffin Valve Co., Boston. On the hand-operated stands, small compact forged steel

gears with cut teeth have replaced the larger cast-iron gears with cast teeth formerly used. The stands are now constructed so that all gears are totally inclosed from the weather and run in oil. On the larger hand-operated stands and on all of the electrically operated stands bronze worm gears and steel worms are employed. A new feature of the electrically operated stand is the means provided for disconnecting the motor drive when throwing in hand operation and *vice versa*.

Pipe Cutters in Larger Sizes

Three new and larger sizes have been added to the line of Beaver square-end pipe cutters manufactured by the Borden Co., Warren, Ohio. The range of pipe diameters for which these new tools have been designed is 2½ to 6 in.,



4½ to 8 in., and 9 to 12 in. The basic principle of these cutters is the use of knives which operate like a lathe tool, removing a thin shaving at each turn and quickly cutting the pipe square without burrs. The cutting knives feed automatically and the device may be operated either with a hand ratchet handle or by power. The knives are made of vanadium steel and are fitted with guides which ride ahead of the cutting point to limit the depth of cut.

The essential advantage of this new tool, its manufacturer points out, is that it is driven by a pinion which operates a gear. This type of construction has a gear ratio that reduces the amount of power required to turn the tool and cut the pipe. Furthermore, as the pinion remains stationary throughout the cutting operation the tool can be used advantageously in trenches and other close quarters.

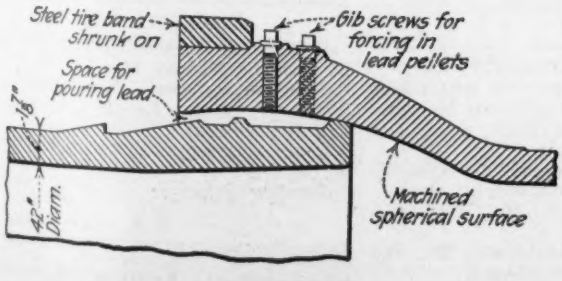
Flexible Pipe Joint Improved

An improved type of flexible joint for submarine pipe lines is offered by the United States Cast Iron Pipe & Foundry Co., Burlington, N. J. It was designed originally for the first 36-in. Narrows siphon of the Catskill aqueduct under the New York Harbor ten years ago, and is being used on the second and larger (42-in.) line adjacent to the first one now under construction.

The joint is a modification of the Ward joint, in which the inside of the bell is accurately machined and polished to a true spherical surface, on which the lead adhering to the spigot slides without abrasion.

The joint on the new line is practically the same as that formerly used, except that closer attention has been paid to securing a smooth spherical surface on the bell end and the gib-screw holes in the circumference of the bell, through which pellets of lead and lubricant are injected into the joint to fill up the shrinkage space after it has been filled with molten lead, have been enlarged. Further details on the project appear in an article on p. 838.

The pipe is laid with the use of a special cradle and in forming the joint lead is calked throughout the bell instead of only on the surface. The new siphon line is 9,400 ft. long and is laid from 60 to 72 ft. below mean sea level. The type of joint described is furnished for all standard sizes of pipe from 16 to 48 in., and has a maximum deflection angle of 10 deg. 30 min.


Steel tire band shrunk on
Gib screws for forcing in lead pellets
Space for pouring lead
Machined spherical surface
42" Diam.

Backfiller Has Improved Features

In the design of its latest type of backfiller the Austin Machinery Corporation, Toledo, Ohio, has laid emphasis on compactness, simplicity and ruggedness. Every function of the machine, illustrated herewith, is performed by power and controlled by lever. The

levers have a dual action, operating both the clutch and the brake, thus eliminating foot pedals. Power is supplied by a heavy duty, four-cylinder gasoline engine. Every part of the main machinery is mounted on the top side of the main frame making it accessible for adjustment. Among the principal features of the new backfiller are: A box lattice type boom; a 180-deg. swing for the power-operated boom; boom raised and lowered by power; forced feed lubrication.

Portable Machine for Cutting and Threading Pipe

For cutting off, threading or reaming pipe the Williams Tool Corporation, Erie, Pa., has developed a new portable unit which is belt-driven by a 1-hp. electric motor in the base of the machine; a hand drive also is pro-

vided. The machine, which is named the "Willie Williams," has a capacity for cutting either right- or left-hand threads on pipe ¼ to 2 in. in diameter and on bolts from ⅜ to 1½ in. inclusive. The longest run thread at one chucking is 10½ in. By using an adjustable shaft the equipment will operate hand stocks up to and including 8 in. The outfit with 1-hp. motor and all standard parts weighs 520 lb. and is designed to fill a gap between the large heavy power machine and the hand stock.

The front gripping or driving chuck is of the three-jaw universal self-centering type. On the rear of the spindle is a three-jaw self-centering scroll chuck for centering long lengths of pipe; this is operated by a hand wheel. Four sets of dies are furnished with the machine as standard equipment, one set cutting ¼ and ⅜ in., the second ½ and ¾ in., the third 1 and 1¼ in., and the fourth 1½ and 2 in.

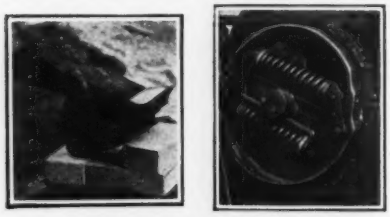
An accessory feature of the portable machine is a high-speed emery wheel driven direct from the motor.

The threading of pipe above 2 in. in diameter is accomplished by chucking a universal shaft in the power machine and attaching its other end to a hand stock of proper size. The revolving chuck then supplies the power to operate the hand stock.

The flow space accupied by the machine is approximately 2 x 3 ft.

Vertical Boom Ditcher Has Spring Overload Release

Several recent improvements have been made by the Barber-Greene Co., Aurora, Ill., in its vertical boom ditcher designed for digging trenches up to a maximum depth of 5 ft. 6 in., and either 9 or 18 in. wide. One of the principal changes is the design of the buckets which form part of the chain and open automatically as they pass over the head of the sprockets, thus insuring a positive discharge of the excavated material. The new buckets have been made deeper than formerly and the cleaning lip has a greater swing; sides have been added and the projection of the manganese steel teeth extended. In the digging position the bucket line is prevented from doubling in by having



Bucket and Spring Release

the units mounted one upon the other so that the digging pressure is distributed along the whole line.

To prevent damage to the machine in case some solid construction is encountered a mechanical spring cushion overload release device has been built into the driving sprocket for the bucket line, as shown in the illustrations herewith. When an overload is placed on the boom the springs in the overload release are compressed and the sprocket slips and rotates, releasing the load.

On the new model ditcher, which is mounted on crawler treads 3 in. longer than formerly, a better distribution of weight has been secured by mounting the 38 hp. 4-cylinder Hercules gasoline motor just outside of the frame, instead of just inside where it formerly was. The crawler frame is now being made as a one-piece steel casting.

Digging speeds of 12, 18, 24 and 36 in. per minute are provided. The machine has three traveling speeds forward and one reverse. Overall dimensions of the ditcher are: Length, 15 ft. 8 in.; height, with boom raised, 12 ft.; width, 5 ft. 8½ in.; weight, 14,400 lb.

Additional water-works equipment news will appear in the Convention Report Issue, May 29.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Value of Sewer Contracts for First Quarter Heavier Than in 1923

Statistics from *Engineering News-Record* covering sewer awards of $25,000 and over show that 1923 completed a larger money value of awarded contracts than any of the six preceding years. The awards for 1924 in all the geographic sections for the first quarter are heavier than those of 1923. During the month of April, there was a falling off in the New England and the Middle Atlantic sections making the totals for the first four months of 1924 and 1923, $14,046,000 and $14,883,000 respectively.

The growth of sewer construction may be seen from the following figures:

Year	Value	Year	Value
1913	$26,906,000	1920	$36,067,000
1917	33,386,000	1921	39,385,000
1918	17,597,000	1922	43,584,000
1919	38,506,000	1923	66,905,000

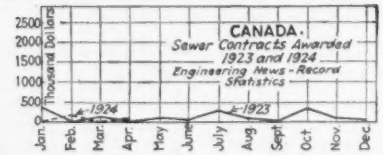
1924 (first 4 months) $14,046,000

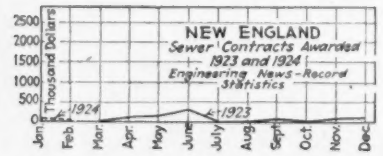
A comparison of sewer work by geographic sections for 1924 and 1923 is made by the following tabulation of the first four months of each:

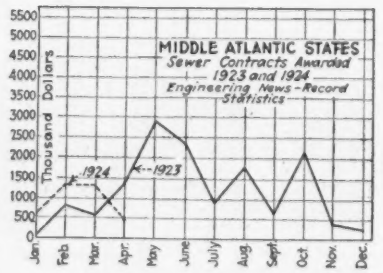
	1924	1923
New England	$60,000	$116,000
Middle Atlantic	3,753,000	3,222,000
Southern	1,132,000	511,000
Middle Western	4,469,000	7,544,000
West of Mississippi	2,510,000	2,253,000
Far West	2,122,000	1,237,000
Total	$14,046,000	$14,883,000

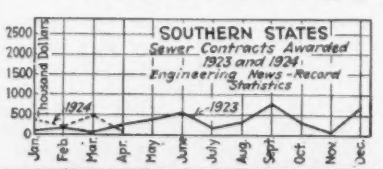
The trend of sewer construction for 1924, based upon figures taken from the natural divisions into which all work is divided during its progressive stages as published in Construction News, is indicated by the following data covering the first four months of the year:

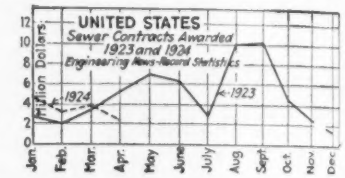
	No.	Value
Proposed work	330	$52,081,000
Bids desired	158	9,590,000
Bids received	102	11,756,000
Contracts let	164	13,969,000

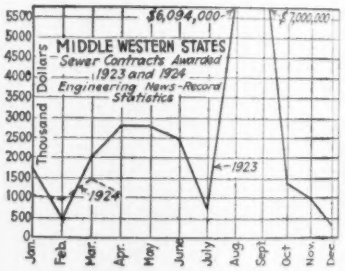


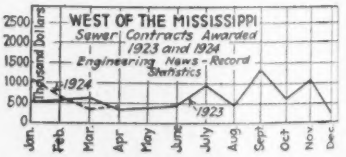


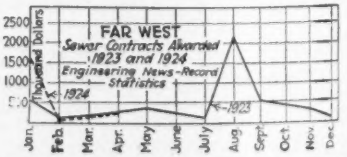












Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 279 to 294, are the following:

Orphanage, Cleveland, O., Catholic Charities Corp., $2,000,000.

Market, St. Louis, Mo., City, $1,350,000.

High School, Baltimore, Md., by Board of Awards, $1,000,000.

Business Briefs

Call money market dull with rate at 3½ per cent, Monday, May 12.

Time money quiet. Short loans at 3¾@4 per cent. Longer periods at 3¾@4¼ per cent.

Commercial paper, all names, brought 4½ per cent.

Foreign exchange:

	This Week	Last Week	Year Ago
Sterling (Demand)	$4.36¼	$4.38¼	$4.62½
Franc (Demand)	0.0560¼	0.065	0.0663½
Lira (Demand)	0.0442½	0.0449½	0.0488½

April Public Bond Sales Heaviest This Year

The public bond sales for the month of April totaled $126,987,418 which makes the largest total for any month this year, according to *The Commercial and Financial Chronicle*. Nearly half of this total is due to the heavy borrowings of the States of New York and Illinois and the Chicago Sanitary District. The above amount for April may be compared with the March total of $99,189,994 and with $80,467,586 for April of 1923.

New York State marketed $45,000,000 4½ per cent serial gold bonds the past month. Illinois placed $10,000,000 4½ per cent bonds, while the Chicago Sanitary District sold $5,000,000 4 per cent bonds making a total for the three of $60,000,000.

Among the other important issues of the month were:

$3,300,000 4½ per cent water bonds of Kansas City, Mo.; $2,500,000 5 and 5½ per cent real estate bonds of the State of North Dakota; $2,000,000 State of Michigan highway improvement bonds.

In the accompanying bond table, four of the issues went at par while the other forty-six were placed above par. The interest ranged from 4½ to 6 per cent. Fifteen of the items sold as 4½s. and nineteen as 5s. Only two from the list brought 6 per cent.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 279 to 294, are the following:

Apartment, New York, N. Y., J. Paterno by day labor, $4,000,000.

Hotel and shop, St. Louis, Mo., Mayfair Investment Co. to P. J. Bradshaw, $2,000,000.

Office, Chicago, Ill., K. M. Vitzthum & Co., to Thompson-Black, $2,000,000.

Apartment, New York, N. Y., Brown, Wheelock, Harris, Vought & Co. to Dwight P. Robinson & Co., $1,500,000.

Hotel, Atlantic City, N. J., Hotel Dennis to Turner Constr. Co., Philadelphia, $1,500,000.

Store, Philadelphia, Pa., Frank & Seder to P. M. Sax, $1,000,000.

Drainage Prices in Wisconsin

An argument pleaded in court proceedings for carrying out at this time the work of the Pensaukee Drainage District, in Wisconsin, was the favorable bid received from reliable bidders for this construction. According to the quarterly report of the State Engineering Department the work estimated to cost $304,000 could have been let for about $200,000 (7.43c. per cubic yard for excavation.) The bids on open work were on a pre-war basis and the tile bids showed a substantial reduction from last year's prices. But the court postponed the work owing to petitions on account of agricultural depression and also owing to the refusal of the larger landowners to pay 33 per cent of their drainage tax in advance.

Contract Value for Week of May 8 Heaviest This Year or Last

The total money value of awarded contracts as published in *Engineering News-Record* for the week of May 8 was $69,148,000. This is the peak so far this year and it also exceeds any week in 1923. The two weeks of the past year which approach this amount are those ending April 26, and Oct. 18, with awards of $63,909,000 and $61,908,000, respectively.

The minimum costs observed in Construction News, on each class of construction are as follows: Waterworks and excavations, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

The awards of May 8—$69,148,000—include the $15,000,000 McCorkle Pipe Line of San Antonio, Tex., which will run from Duncan, Okla. to Corpus Christi, Tex.

In the present year, the weeks of Feb. 21 and March 27 had money value totals of $54,188,000 and $51,496,000, respectively. The slowest week so far was Feb. 14 with $18,628,000. This may be compared with Aug. 16, 1923 with awards of $19,391,000.

REPRESENTATIVE PUBLIC BOND SALES, APRIL, 1924

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Michigan	Highways	$1,110,000	4½	100.05	4.247	May 15	1944	Detroit Syndicate
		890,000	4½	100.05	4.49			
County								
Allen, Ind.	Roads	12,000	5	101.10	4.79	Mar. 15	1925—34	The Fletcher American Co. of Indianapolis
		10,500	5	101.05	4.80			
		23,000	5	100.97	4.81			
Benton, Ind.	Roads	24,500	5	101.06	4.79	Mar. 29	1925—34	Breed, Elliott & Harrison of Indianapolis
Bernalillo, N. Mex.	Court House	500,000	5	100.286	4.98	Apr. 7	1954	Geo. W. Vallery of Denver and others.
Becker, Minn.	Roads	250,000	4½	102.28	4.64	Apr. 1	.....	Northwestern Trust Co. of St. Paul and others.
Champaign, Ill.	Roads	1,000,000	5	102.28	4.61	May 1	1925—43	Ames, Emerich & Co. of New York and others
Cuyahoga, O.	Roads	930,000	5	102.64	4.73	Apr. 1	1925—49	Ames, Emerich & Co., of New York and others
Douglas, Minn.	Roads	175,000	4½	100.06	4.49	Apr. 1	1935—44	Lane, Piper & Jaffray, Inc., of Minneapolis, and others
Dubois, Ind.	Roads	88,400	4½	100	4½	Apr. 15	1925—34	Birds Eye Nat. Bank of Birds Eye, and others
Dodge, Wis.	Highway	300,000	5	103.15	4.67	Apr. 1	1928—44	Detroit Trust Co. of Detroit
Erie, Pa.	Roads	800,000	4½	.....	.....	Mar. 1	1939—44	Harris, Forbes & Co. of New York and others
Fillmore, Minn.	Roads	150,000	4½	100.103	4.49	Apr. 1	.....	Wells-Dickey Co. of Minneapolis
Franklin, O.	Bridge	35,700	5½	102.58	4.98	Sept. 15	1925—33	W. L. Slayton & Co. of Toledo
Geauga, O.	Roads	120,300	5½	102	5.03	Mar. 1	1925—33	W. L. Slayton & Co. of Toledo
Harris, Tex.	Road and bridge	250,000	5	101.94	4.86	Apr. 10	1945—54	Sidney Spitzer & Co. of New York
Hudson, N. J.	Hospital	1,680,000	4½	100.24	4.48	May 1	1925—54	First Nat. Bank of New Jersey, and others
	Park	399,000	4½	100.30	4.48	May 1	1925—72	
	Boulevard	880,000	4½	100.04	4.49	May 1	1925—38	
	Turnpike	340,000	4½	100.04	4.49	May 1	1925—38	Hoffman & Co. of New York
Jim Wells, Tex.	Roads	100,000	5½	100	5½	.....	.....	First Nat. Co. of Corpus Christi
Lane, Ore.	Roads	200,000	5	100.75	4.96	.....	.....	Robertson & Ewing of Portland and others
Milwaukee, Wis.	Sewer	3,736,000	4½	100.6569	4.68	Apr. 1	1935—44	A syndicate
Montgomery, O.	Water	170,000	5½	105.58	4.86	Mar. 1	1926—45	Provident Savings & Trust Co. of Cincinnati
		320,000	5½	105.13	4.93	Apr. 1	1926—45	Breed, Elliott & Harrison of Toledo
Marlboro, S. C.	Roads	350,000	5	100.11	4.99	Apr. 1	.....	J. H. Hilsman & Co. of Atlanta
Norfolk, Va.	Road and bridge	220,000	5	100	5	Apr. 1	1944	R. M. Grant & Co., Inc., of New York
Porter, Ind.	Roads	50,000	5	101.11	4.79	Mar. 15	1925—34	The Fletcher American Co., of Indianapolis
Ramsey, Minn.	Road and bridge	1,000,000	..	100	4.63	.....	1925—44	A syndicate
Smith Tex.	Roads	120,000	5½	10 .41	5.31	Apr. 10	1943—50	Stern Bros. & Co. of Kansas City and others
Scott, Minn.	Roads	250,000	4½	101.53	4.67	.....	.....	Northwestern Trust Co. of St. Paul and others
Township								
Hartford, O.	Roads	20,000	6	102.65	5.475	Apr. 1	1925—34	Benjamin, Desard & Co. of Detroit
North Bergen, N. J.	Gen. improvements	239,000	5	100.22	4.97	Mar. 15	1926—38	R. M. Grant & Co. of New York
Municipalities								
Andover, Mass.	Hospital	70,000	4½	101.19	4.20	Apr. 1	1925—34	Commonwealth Atlantic Bank of Boston
Beacon, N. Y.	Dam and building	310,000	4½	100.38	4.46	Oct. 1	1925—43	Sherwood & Merrifield of New York
Batavia, N. Y.	Streets and water	129,000	4½	100.03	4.495	Jan. 1	1925—44	Frazier, Jelke & Co. of New York
Charleston, S. C.	Paving	545,000	6	100.609	5.90	Apr. 1	1926—35	Peoples National Bank of Charleston
Dowington, Pa.	Water	135,000	4½	101.662	4.36	May 1	1929—53	West & Co. of Philadelphia
East Cleveland	Street improvement	145,000	5	100.708	4.88	Apr. 1	1925—36	Illinois Merchants Trust Co. of Chicago
Erie, Pa.	Sewer	225,000	4½	102.05	4.32	May 1	1926—54	Erie Trust Co. of Erie
Glendale, Calif.	Sewer	652,000	5	101.40	4.87	Mar. 1	1925—61	Anglo London Paris Co. of Los Angeles and others
Greenwood, Miss.	Paving	96,000	5½	102.38	5.25	Apr. 1	1925—44	Hibernia Securities Co. of New Orleans
Grand Rapids, Mich.	Street and sewer	757,500	5	101.71	4.58	Apr. 1	1925—34	Austin Grant & Co. of New York and others
Holyoke, Mass.	Highway and bridge	275,000	4½	101.020	4.207	Apr. 1	1925—44	Estabrook & Co. of Boston
Lakewood, O.	Water and sewer	156,000	5	101.65	4.82	Apr. 1	1925—49	Perry, Stacy & Co. of Chicago
Larchmont, N. Y.	Sewer	246,280	4½	100.69	4.45	May 1	1925—64	Harris, Forbes & Co. of New York
Marshalltown, Ia.	Water	300,000	5	100.88	4.66	Oct. 1	1925—44	Ringheim, Wheelock & Co. of Des Moines
Morristown, N. J.	Water	716,000	4½	101.33	4.405	Apr. 1	1925—64	Eldredge & Co. of New York and others

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers have been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number is given.

Zinc plant to be erected in Mexico. This work is to be done at once. It is planned to have the plant in operation during last half of 1924. Reference No. 125,532.

Water power concessions will be granted by Greece. Development of industry and reclamation of unproductive areas are the reasons for such a move. Reference No. 15,530.

Waterworks to be installed in city of Harbin, Manchuria. A concession for waterworks and sewerage to be granted within the city. Reference No. 124,499.

Hotels to be built in east China by a company operating a number of hotels in the Far East. Reference No. 126,595.

Street improvement for Spanish city is now under consideration. Lacking experience, the city is looking for help in this type of construction. Reference No. 126,815.

New theater for Colombia. Construction of large theater building, a part of which will be a hotel. Steel, cement, decorations and furnishings to come from the United States. Reference No. 16,278.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 1, the next, on June 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.59	+$3.80	$4.40	$3.30	$3.55	$4.20	$3.60	$3.60	$4.20
Structural rivets, 100 lb.	—4.00	—4.35	4.90	3.75	4.00	5.15	5.00	4.25	5.00
Reinforcing bars, ¾ in. up, 100 lb.	3.49	+3.30	3.38	3.20	3.45	3.85	3.65	3.50	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	47%	55.05%	36%	36.80@49.10%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	55.00	61.00	57.20@60.20	60.50	69.00	—59.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	2.00	2.38	2.00	1.85	1.90	2.15	1.50	1.50
Sand, cu.yd.	1.25	1.40	2.00	2.00	1.25@1.50	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61.00	40.00	60.22	53.50	41.75@43.00	49@53	36.00	27.00	65.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.65	1.85	1.50	1.40	2.70	2.10	2.80	10.50
Common brick, delivered, 1,000	23.65	12.00	14.10	11.00	15.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.091	.11	.064	.075	.075	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.091	.11	.....	.....	.075	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.98	1.00	+1.11	.94	1.06	+1.15	1.05	1.13	1.21
Common Labor:									
Common labor, union, hour	.75	.30	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.22). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

If steel and lumber can be taken as indicators of current demand for basic building materials, the market is quieter than a year ago.

Unfilled orders on books of the U. S. Steel Corporation, April 30, totaled 4,208,447 tons, against 4,782,807 for the month preceding and 7,288,509 tons one year ago. The decrease in unfilled tonnage to the extent of 574,360 tons in one month indicates a smaller volume of business in steel.

The national lumber movement for the week ended May 3 shows a general falling off in production, shipments and demand. Orders for that week totaled 239,299,839 ft., against 246,267,293, for the preceding week and 241,123,444, for the corresponding period in 1923.

Contrary to the trend of lumber and steel, however, is the case of common brick, which increased in demand about 26 per cent in thirty days. Lime and cement are also reported in good demand, particularly in New York.

The outstanding declines of this week's market are a reduction of 15c. per 100 lb. on structural rivets in Atlanta; a drop of $1 per ton in 6-in. c.-i. pipe in San Francisco and a decline of $2 per M. ft. in long-leaf yellow pine timbers in the New York market. Linseed oil, however, advanced 2c. in Dallas; 3c. in New York and 4c. per gal. in Denver, during the week.

The value of April building permits in Los Angeles was $2,128,376 under the same month last year, while St. Louis reports a gain of $9,039,902 this year compared with April, 1923. New York City is at present enjoying a record construction boom as indicated by the scarcity of bricklayers. While the base pay of bricklayers in this city is $12 per day, considerable difficulty is experienced in obtaining mechanics at $14 and $16 per day.